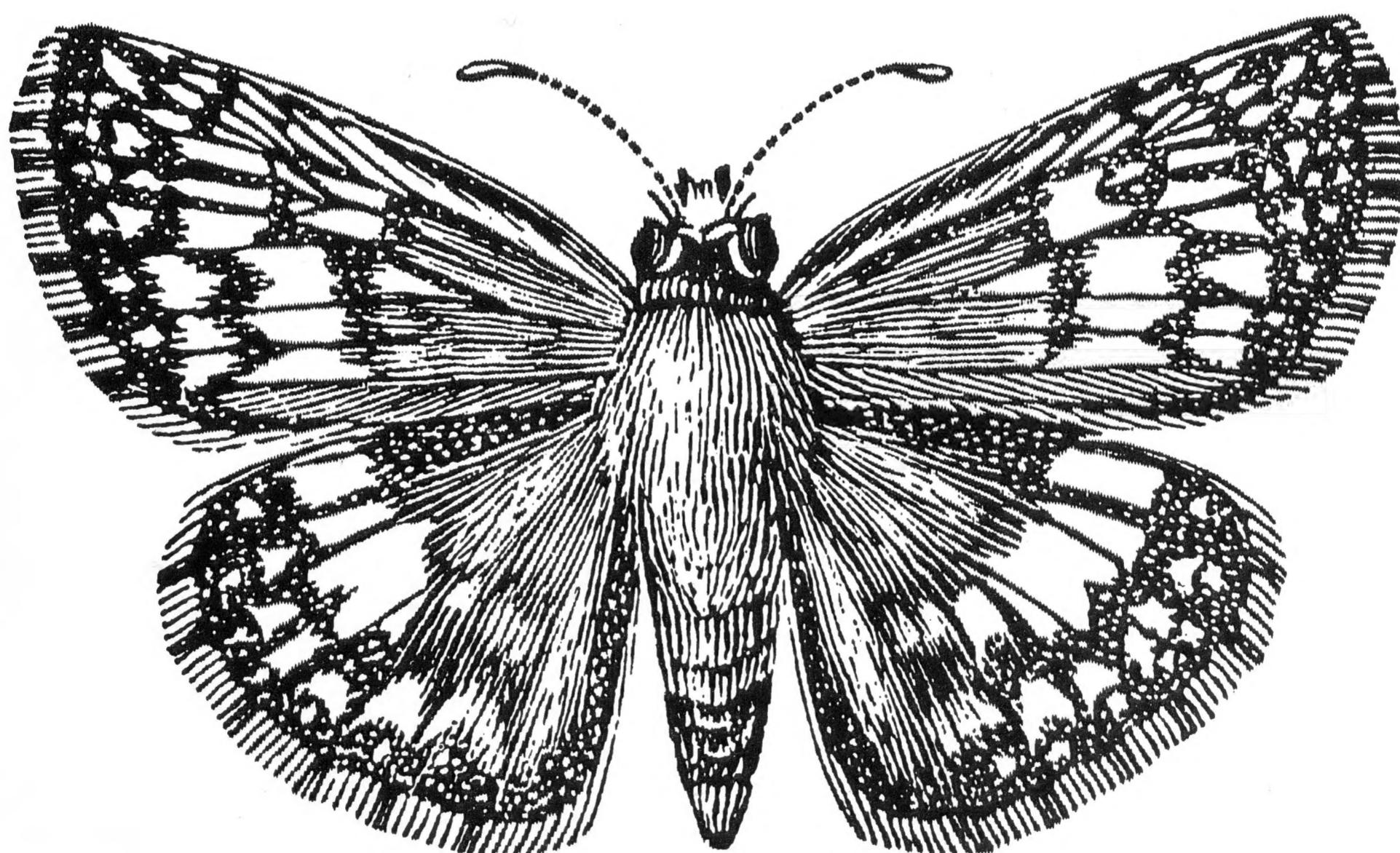


QL
541
A88
ENT

ATALA

The Journal of Invertebrate Conservation

Volume 16 (1-2), 1990



THE XERCES SOCIETY

An international, nonprofit organization dedicated to the global protection of habitats for butterflies and other invertebrates. Named for the extinct Xerces Blue Butterfly, *Glaucomysche xerces* (Boisduval). Founded on 9 December 1971.

OFFICERS

Melody Mackey Allen	<i>Executive Director</i>
E.O. Wilson	<i>President</i>
Paul A. Opler	<i>Vice President</i>
Ed Grosswiler	<i>Secretary</i>
Katherine A. Janeway	<i>Treasurer</i>

COUNSELORS

Spencer B. Beebe	G. Evelyn Hutchinson	Robert Michael Pyle
Jo Brewer	Robert E. Jenkins	Nathaniel Reed
Lincoln P. Brower	Thomas Lovejoy	Charles L. Remington
Paul R. Ehrlich	Michael G. Morris	Hon. S. Dillon Ripley
Adrian B. Forsyth	Margaret Murie	Hon. Miriam Rothschild
Paul Hawken	Roger Tory Peterson	

BOARD OF DIRECTORS

Kenneth Berlin	Terry L. Erwin	Scott E. Miller
F.S. Chew	David Furth	Paul F. Milner
Jeffrey A. Curtis	Lawrence Gall	J. Kathy Parker
Joan DeWind	Jeffrey Glassberg	Michael H. Robinson
Thomas Emmel	Daniel H. Janzen	Jack Vaughn

MEMBERSHIP INFORMATION

Membership in the Xerces Society is open to all interested persons and institutions upon submission of appropriate dues. For the 1990 calendar year, one-year membership rates (in U.S. dollars) are as follows: regular \$25.00, institutional \$40.00, student \$15.00, retired \$15.00, supporter \$50.00, friend \$100.00, patron \$250.00; a lifetime membership is \$1,000.00. Members outside North America please include an additional \$5.00 to cover overseas mailing expenses. All members and institutional subscribers receive the occasional journal *Atala*; the magazine *Wings* three times yearly; the *4th of July Butterfly Count* summary upon request; and Society meeting announcements, and other communications. Xerces Society publication and administration costs are covered by dues and contributions, all of which are tax-deductible.

A person or institution interested in receiving Xerces Society publications should submit name, address, and appropriate dues to *The Xerces Society, 10 Southwest Ash Street, Portland, Oregon 97204*. Changes of address, requests for back issues of all publications, and correspondence about invertebrate conservation issues and Xerces Society policy should also be sent there. Contributions to the Xerces Society journals *Atala* and the annual *4th of July Butterfly Count* should be sent to *Atala* editor and Butterfly Count Coordinator *Paul A. Opler, 5100 Greenview Court, Fort Collins, Colorado 80525*. Items for inclusion in the Xerces Society magazine *Wings* should be addressed to the Editor, *Mary Troychak, The Xerces Society, 10 S.W. Ash Street, Portland, Oregon 97204*.

Published at Portland, Oregon, USA in August 1990 by the Xerces Society, Inc.
Copyright 1990 by the Xerces Society.

ATALA

The Journal of Invertebrate Conservation

Volume 16 (1-2)

1990

Dense Colonies of the South Texas Tree Snail

(Rabdotus alternatus): An Endangered Phenomenon?

Raymond W. Neck

Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744 USA

Abstract

Individuals of the bulimulid land snail, *Rabdotus alternatus*, are relatively common in southern Texas and northeastern Mexico. Highly localized, dense colonies of this species are very rare today, although historical accounts indicate that these colonies were common prior to widespread alteration of natural communities. Preferred habitat of these colonial populations is described from field surveys.

Introduction

Most species-specific conservation efforts have concerned plants or vertebrates, particularly birds and mammals. Recently, more concern has been evinced toward conservation of invertebrates as the recent "red-data volume" concerning invertebrates (Wells et al., 1983) discussed several hundred species from protozoans to arthropods and echinoderms. Two examples of threatened phenomena were included: winter roosts of the monarch butterfly (*Danaus plexippus* Linnaeus) and a supercolony of a Japanese wood ant (*Formica yessensis* Forel). Threatened phenomena are particular congregations of a species which are very rare even though the species involved may be relatively common.

Rabdotus alternatus (Say, 1830), is a terrestrial snail that occurs in southern Texas and much of the arid and semi-arid areas of northeastern Mexico (Pratt, 1974). While the geographic distribution of *R. alternatus* in southern Texas is well-known (Fullington and Pratt, 1974), only limited ecological information is available for this species. Simmons (1954) merely mentioned that the habitat of this species "is chiefly in the Rio Grande plain . . . the brush country." Hubricht (1960) reported that snails spend the cool season underground. While some colonies remain underground and come to the surface only at night after rains, most colonies spend the summer on shrubs to escape the excessively heated soil surface. In some colonies individual snails occur on all plant species in the area while some colonies exhibit snails preferentially on a few of the many plants species present. Upon a superficial survey, Hubricht (1960) found no obvious differences between areas with and without colonies.

R. alternatus has been abundant in southern Texas for several thousands, probably tens of thousands, of years. Large numbers of shells of *R. alternatus* are present in Holocene and Pleistocene deposits of the lower portion of the Rio Grande (Penrose, 1890; Richards, 1939; Trowbridge, 1932). Large accumulations of shells are found in

archeological sites in southern Texas (Clark, 1973) and northeastern Mexico (MacNeish, 1958) which date to the Early Holocene. Undoubtedly, aboriginal inhabitants of this region collected living snails for food in prehistoric times (MacNeish, 1958; Neck, unpub. data).

Dense colonies of *R. alternatus* have long intrigued human travelers in southern Texas. A U.S. Army officer, W.S. Henry, mentioned such a colony in a diary of his activities during the 1846-1848 war between the United States and Mexico. Henry (1847:141) stated that "the limbs of the chaparral were so thickly covered with snails that at first they looked like white flowers; it is a common sight to see the little animals in such numbers." Binney (1885:397) reported that *R. alternatus* is "found in great numbers upon bushes, the ground below them being often covered with dead shells." Singley (1889) and Townsend (1897) reported that *R. alternatus* was abundant. Ferriss (1924:39) remarked that, after a warm April shower, *R. alternatus* climbed upon the shrubs which "looked like stands of the white snowberry in fruit." Jacobson (1952:114) reported that the "bushes . . . were covered with hosts of aestivating [*R. alternatus*]."

Unfortunately the "little animals in such numbers" are no longer a common sight. Low density populations of *R. alternatus* are still commonly encountered in southern Texas, but personal field surveys over a ten-year period in southern Texas have revealed colonies of *R. alternatus* at only two localities. The purpose of this article is to discuss colonies of *R. alternatus* as a possible endangered phenomenon and to suggest topics for future research.

Methods and Results

Field surveys of colonies of *R. alternatus* were performed at Bentsen-Rio Grande Valley State Park (B-RGV), Santa Ana National Wildlife Refuge (SA) [both located along the Rio Grande in Hidalgo, Co., Texas], and Resaca de la Palma State Park (RP), Cameron Co., 3 km north of the Rio Grande. Surveys were accomplished by driving and walking through sites with native and secondary growth brush communities. The study sites contain a mosaic of subtropical thorn woodland, thorn savannah, and riparian woodland which is influenced by variations in soils and land-use history. Subtropical thorn woodland contains a variety of

shrubs and small trees. Dominant species are Texas ebony, *Pithecellobium flexicaule* (Benth.) Coulter; colima, *Zanthoxylum fagara* (L.) Sargent; granjeno, *Celtis pallida* Torrey; brasil, *Condalia hookeri* M.C. Johnston; snake-eyes, *Phaulothamnus spinescens* Gray; and lotebush, *Ziziphus obtusifolia* (T. & G.) Gray. Thorn savannah is an early successional community following abandonment of agricultural land. Dominant species are mesquite, *Prosopis glandulosa* Torrey; pricklypear cactus, *Opuntia lindheimeri* Engelmann; huisache, *Acacia smallii* Isely; and retama, *Parkinsonia aculeata*. Riparian woodland is dominated by cedar elm, *Ulmus crassifolia* Nuttall; brasil; Rio Grande ash, *Fraxinus berlandieriana* A.C. de Candolle; and Texas sugarberry, *Celtis laevigata* Willd.

Field surveys and interviews with preserve personnel revealed the limits of high-density populations of *R. alternatus*. These limits were compared to topographic maps, soil maps, and color infra-red aerial photographs (to delineate plant communities; see Neck et al., 1987). These analyses and on-site comparison of habitats with and without snail colonies provided an initial analysis of the ecological determinants for allowing dense populations of *R. alternatus*.

A single, extensive colony of *R. alternatus* was mapped at B-RGV (observations made 20 Oct 1984). *R. alternatus* was most abundant ($18.6/m^2$) where tall mesquite and cedar elm were dominant; snails were observed up to 11 m above soil level. Population concentrations were found in areas with a tall understory (15 m) and limited grass and herbaceous plants. The colony is associated with the area of highest local elevation, although elevation differences in the park range only from 32 m to 37 m above mean sea level.

On 11 September 1986, I surveyed the relative densities of *Rabdotus alternatus* along a hiking trail at B-RGV. Biological communities in the area traversed by the trail are varied but can be grouped into three classifications: 1) an early successional savannah/open woodland, 2) a mid- to late successional thorn woodland with a mosaic of open and closed canopy, and 3) a climax riparian woodland with closed canopy. Number of living snails and intact dead shells (not brought into area by predators) per linear meter for the three community types respectively are 0.19, 1.58, and 0.04. Optimum habitat of *R. alternatus* in this area occurs in the thorn woodland in an upland, well-drained environment.

Initial observations at SA on 29 Dec 1970 revealed several hundred *Rabdotus alternatus* in areas of brush (average density of $4.3/m^2$). *R. alternatus* was more common in the *Acacia smallii* - *Pithecellobium flexicaule* community, although snails were present in areas dominated by *Ulmus crassifolia*. A survey of SA on 18 November 1986 revealed a few areas with moderate densities (average of $1.8/m^2$) of *R. alternatus*, but no areas supported populations similar to the colony at B-RGV. The reduced population level in the originally-observed colony area may be due to environmental alterations or normal cycles in population levels.

An additional survey was taken at RP on 26 September 1984, even though only scattered accumulations of a few living snails (no colonies) of *R. alternatus* have been observed at this site. However, nearby agricultural fields contain numerous dead shells in the surface layers of the soil. Surveys of a series of 1m by 5m plots revealed the largest number of *R. alternatus* shells (25.8 shells per plot) in topoedaphic conditions which would have been well-drained and naturally would have supported open to semi-closed woodlands. Areas of potential thorn woodland contained many fewer shells (14.8 shells per plot). Open woodlands with heavier soils (on backslope of natural levee) contained only a few shells (5.5 shells per plot) while no shells were found in potential interdistributary marsh areas with heavier soils.

Discussion

Human utilization of southern Texas has involved extensive agricultural utilization (both farming and ranching). Thousands of acres of native savannahs and thorn woodlands have been cleared of native vegetation and utilized for row crops or pastures (Foscue, 1934). A recent list of restricted and declining nonmarine molluscs of Texas did not include *R. alternatus* as a species threatened in southern Texas (Neck, 1984). However, the existence of high-density colonies of *R. alternatus* appears to be endangered.

Environmental factors which determine the site of these colonies probably interact in a complex and variable manner. Soil variation in pH, particle size distribution, and drainage may be significant in oviposition, hatching percentage, and overwinter survival. Solar exposure of snails on branches and trunks is also likely to be significant. The proximate factors of site suitability are likely to be further controlled by stochastic factors, i.e., accidents of

colonization, predation pressure, etc. A modern factor, past land-use patterns, now has been superimposed upon the environmental and stochastic limits which influence occurrence of dense colonies of this species.

The single area of a high-density *R. alternatus* colony at B-RGV is located in an area of open thorn woodland in an area of limited soil variation and slightly higher elevation than the surrounding land. Identification of a single determining factor in this melange of interacting factors is difficult and may not reflect biological reality. However, the elevational high allows reduced impact of periodic flooding. The openness of an area is likely to be a major factor; no colonies or even medium-density populations have been observed in remnant areas of the thick, almost impenetrable, thorn woodlands which once covered much of the area along the Rio Grande.

Studies of the temporal dynamics of these colonies have commenced (Neck, in progress). As expected, snail density and colony expanse (at B-RGV) vary with time, probably in relation to temporal distribution of precipitation. The area presently occupied by the B-RGV colony was agricultural land prior to the 1930's. Hubricht (in litt., 18 Dec. 1985) reported that he found no *R. alternatus* at B-RGV during the 1950's. The B-RGV colony was present in 1965, however (Salinas, pers. comm.). Early successional habitats do not appear to be suitable for dense colonies of *R. alternatus* unless an existing colony is located nearby to provide continual immigration.

Pilsbry and Ferriss (1906:140) recognized two forms of *R. alternatus* in southern Texas: an eastern form which occurs generally in areas of the Gulf Coastal Plain underlain by Tertiary and Quaternary sediments, and a western form which occurs on soils generally underlain by calcareous Cretaceous sediments. Although not specifically stated by Pilsbry and Ferriss (1906), thorough reading of their comments indicates that the tendency to form discrete colonies may be a characteristic which is exhibited more noticeably by the eastern form; such a tendency agrees with my observations. Some temporal stability of these colonies may be inferred from the remark by Pilsbry and Ferriss (1906:040) that "almost every colony of the eastern race has slight peculiarities in shape, relative abundance or absence of the several color forms."

Under "natural" conditions, i.e., prior to massive human alteration of native biological communities, much of southern Texas was grassland with woody plant communities restricted to riparian corridors and rocky ridges. The occurrence of local, densely-populated colonies could merely reflect local occurrence of optimal habitat. Optimal habitat appears to have been localized mesic, well-drained areas with humus-rich topsoil. Local concentrations could have been an adaptation to maintain dense populations in small, delimited areas of woody vegetation in the native grasslands of southern Texas. Snails which dispersed beyond the suitable woody areas would not survive or would suffer reduced reproduction. Social interactions via slime trails could function to maintain high densities.

Identification of specific management techniques designed to conserve and enhance the development of large colonies of *R. alternatus* awaits additional biological information. Existing colonies should be protected from deleterious alterations of the environment. Little is known concerning the establishment of new colonies, although current observations of old field communities at RP have revealed immigration into abandoned agricultural fields with successful reproduction.

My field surveys indicate that *Rabdatus alternatus* is most abundant in open woodlands. The particular plant community is somewhat variable, indicating that habitat structure may be more important than particular species. Two of the more commonly occupied plant communities are: 1) an arrested successional stage of senescent *Prosopis glandulosa* and *Acacia smallii*, and 2) an overmature woodland of *Ulmus crassifolia* with significant dead wood and senescing individuals. The rarity of dense colonies is due to both land-clearing activities and floodwater control. Land clearing destroys existing habitat, whereas control of floodwaters of the Rio Grande results in arrested communities of *Prosopis* and *Acacia* (due to lack of floodwater input of seeds of later successional species). River control has also caused the near elimination of creation of new habitat areas that were formerly created by river course alterations and invigoration due to floodwater input of nutrients and moisture.

Acknowledgments

I thank Leslie Hubricht and J. Antonio Salinas for observations on *Rabdatus alternatus* in southern

Texas. Others who provided observations (usually negative) include Joe Ideker, Robert Schumacher, Gary Wagberman, and James Everitt.

Literature Cited

Binney, W.G. 1885. A manual of American land shells. Bull. U.S. Nat. Mus., 28:1-528.

Clark, J.W. Jr. 1973. The problem of the land snail genus *Rabdatus* in Texas archeological sites. The Nautilus 87:24.

Ferriss, J.H. 1924. On the Rio Grande. The Nautilus 38:37-43.

Foscue, E.J. 1934. Agricultural history of the Lower Rio Grande Valley region. Agric. Hist., 8:124-137.

Fullington, R.W. and W.L. Pratt, Jr. 1974. The Helicinidae, Carychiidae, Achatinidae, Bradybaenidae, Bulimulidae, Cionellidae, Haplotrematidae, Helicidae, Oreohelicidae, Spiraxidae, Streptaxidae, Strobilosidae, Thysanophoridae; Valloniidae (Gastropoda) in Texas. Bull. Dallas Mus. Nat. Hist., 1(3):1-48.

Henry, W.S. 1847. Campaign sketches of the war with Mexico. New York, Harper and Brothers.

Hubricht, L. 1960. The genus *Bulimulus* in southern Texas. The Nautilus, 74:68-70.

Jacobson, M.K. 1952. Some interesting localities on a collecting trip to Mexico. The Nautilus, 65:109-114.

MacNeish, R.S. 1958. Preliminary archeological investigations in the Sierra de Tamaulipas, Mexico. Trans. Ameri. Phil. Soc., 48(6):1-210.

Neck, R.W. 1984. Restricted and declining nonmarine molluscs of Texas. Texas Parks and Wildlife Dept. Tech. Ser. 34:1-17.

Neck, R.W., S.J. Ingle, and M.R. Davis. 1987. Color infrared aerial photography as a tool in identification and conservation of subtropical thorn woodlands in the Lower Rio Grande Valley Pp. 102-108, in Color Aerial Photography and Videography in the

Plant Sciences and Related Fields (J.H. Everitt, ed.).
Proc. 11th Biennial Workshop on Color
Aerial Photography in the Plant Sciences,
Amer. Soc. Photogram. & Rem. Sens., Falls
Church, VA, 343 pp.

Penrose, R.A.F., Jr. 1890. Preliminary report on the
geology of the Gulf of Tertiary of Texas.
First. Ann. Rpt. Geol. Survey Texas, 1889:5-
101.

Pilsbry, H.A. and J.H. Ferriss. 1906. Mollusca of the
southwestern states. II. Proc. Acad. Nat. Sci.
Philadelphia 1906:123-175.

Pratt, W.L. Jr. 1974. A revision of the mainland
species of the bulimulid land snail genus
Rabdotus. Bull. Amer. Malacol. Union,
1973:24-25.

Richards, R.G. 1939. Marine Pleistocene of Texas.
Bull. Geol. Soc. Amer. 50:1885-1898.

Simmons, F.L. 1954. Notes on Texas *Bulimulus*.
The Nautilus 68:20-23.

Singley, J.A. 1889. Shell collecting in southern
Texas. The Nautilus, 3:60.

Townsend, C.H.T. 1897. On the biogeography of
Mexico and the southwestern United States.
II. Trans. Texas Acad. Sci. 2(1):33-86.

Trowbridge, A.C. 1932. Tertiary and Quaternary
geology of the lower Rio Grande region,
Texas. Bull. U.S. Geol. Soc. 837:1-60.

Wells, S.M., R.M. Pyle and N.M. Collins. 1983. The
IUCN invertebrate red data book. Gland,
Switzerland, IUCN.

The Skippers (Hesperioidae) of Rhode Island

With Recent Records of the True Butterflies (Papilionoidea)

Harry Pavulaan
19321 Running Cedar Ct.
Germantown, MD. 20874

Abstract

In the interest of expanding our knowledge of the butterfly fauna of Rhode Island, this survey concentrated on establishing records of the Skipper Butterflies to supplement my original list of the True Butterflies (Pavulaan, 1985). Also included here are additional records of True Butterflies not recorded during the above survey. While many species listed here are known throughout southern New England, most are new records for Rhode Island.

Following are the results of my 1984 survey of the butterflies and skippers of Rhode Island. The great majority of all records were confirmed by documented captures in the several study areas covered, but many records were based on sightings and behavioral characteristics. This task was especially easy in the case of the most common species. Doubtful or questionable sightings were not included.

During 1984, butterfly numbers were greater than those of 1983, with many new species recorded. This was partly due to my discovery of new habitats in many areas. 1984 was characterized by widely-fluctuating weather patterns across the State. An extremely cold but dry January was followed by warm, spring-like conditions in February, with extended periods of rain. Extreme cold returned in early March. Cool, damp, rainy weather prevailed from mid-March through May,

during which rains continued for many days at a time, only to be broken by rare spells of sunshine lasting no more than a few hours, perhaps a day, at a time. This had a considerable effect on collecting. The summer was hot and very dry, with conditions approaching drought by September. Fall was very mild, but freezing weather set in during November, ending the butterfly season.

Most species were recorded from eight primary study areas (Fig. 1), which were visited several times per week throughout the season:

1. Greenville Avenue location, Johnston: A large, wet, sandy area, several acres in extent, apparently bulldozed several years previously. By 1984, parts of the sandy area had become overgrown with weedy, thorny growth (*Rubus*), and groves of young quaking aspens (*Populus tremuloides*). A small elongated pond is the primary feature, ringed by numerous young swamp willows (*Salix nigra*). The area is bordered by mature oak woodland. Wildflowers are abundant, with joe pye (*Eupatorium maculatum*) flowers most conspicuous. Goldenrods (*Solidago* spp.) thrive in late summer.

2. Powerline right-of-way, Warwick: Two sections along the powerline which crosses route 117 just west of Interstate I-95 proved to be excellent places to find a multitude of skippers, some of them quite rare in R.I. The habitat includes extensive open grassy and thorny areas, numerous young wild cherry (*Prunus serotina*) trees, eastern

red-cedar (*Juniperus virginiana*) plantings, and is bordered by mature oak woodlands and residential development. There is an abundance of nectar sources such as goldenrods and wild indigo (*Baptisia tinctoria*) in dry areas, and joe pye flowers in wet areas.

3. West Warwick and eastern Coventry town: This is an old mill town area, with a moderate degree of industry, old residential sections, and a growing amount of commercial development. In the midst of this urban environment is a scattering of numerous vacant or abandoned lots and neglected weedy areas which are overgrown with grasses, weeds, and shrubs. Wildflowers abound here, most notably black-eyed susan (*Rudbeckia hirta*), boneset (*Eupatorium perfoliatum*), dandelion (*Taraxacum officinale*), winter cress (*Barbarea vulgaris*), asters (*Aster* spp.), goldenrods, milkweeds (*Asclepias* spp.), and sunflowers (*Helianthus* spp.). These provided nectar for a thriving population of butterflies and skippers.

4. Northeastern West Greenwich town: A variety of habitat types is found. Most prominent is the "pine barren" habitat (pitch pine (*Pinus rigida*), scrub oak (*Quercus ilicifolia*)) south of Interstate I-95, which proved to be a very poor place for butterflies. However, several grassy weed fields in this area proved rather productive, especially for skippers. Goldenrods abound in late summer.

5. Trestle Trail, central Coventry town: This trail, an abandoned railroad line, cuts through the State's predominant oak forest. There are virtually no nectar sources except for early spring blueberry (*Vaccinium* spp.) blossoms. The area along this trail proved to be very poor for butterflies and skippers.

6. Trestle Trail/Carbuncle Pond area, western Coventry town: This area has typical "pine barren" and mature oak woodland habitats. There is an open, grassy field with wet ditches, in which a variety of wildflowers grow, notably goldenrods and joe pye flowers. Lupines (*Lupinus perennis*) flourish in sandy areas along the trail.

7. Arcadia Wildlife Management Area, Exeter town: A variety of habitats is found here. The predominant habitat is dry, rocky upland oak forest, with extensive areas of dry, sandy "pine barrens", and stands of white pines (*Pinus strobus*). Several grassy fields are found. Large streams cross the area, and a number of small wetlands are found. A unique

feature is the extensive bearberry (*Arctostaphylos uva-ursi*) mats which cover large areas in the "pine barrens" habitat. Wildflowers grow in some open areas and along roadsides, while joe pye flowers thrive in a few open places along streamsides. The oak forest proved to be a very poor place for butterflies, while the open places attracted a fair number of species.

8. Great Swamp Wildlife Management Area, South Kingstown: This location supports the richest diversity of flora and fauna, and the largest variety of butterflies in the State. Mature oak woodland predominates, changing to mixed transition zone forest in some upland sites. Several species of blueberries, American holly (*Ilex opaca*), sweet pepperbush (*Clethra alnifolia*), and scrub oak flourish in the forest understory or at its edges. Different types of wetlands cover extensive areas, much of it wooded. There is a large red maple (*Acer rubrum*) swamp here, and at least two large stands of Atlantic white-cedar (*Chamaecyparis thyoides*), one surrounding a large natural cranberry (*Vaccinium macrocarpon*) bog. Sedges (*Carex* spp.) and common reed (*Phragmites communis*) are common in open wet areas. Several fields are maintained by the Department of Environmental Conservation, many of which were weedy and fallow during the survey. A host of wildflowers thrives in these open areas. Milkweed and joe pye flowers are the most conspicuous, while goldenrods flourish in late summer. Wild cherry trees abound in open areas.

Several secondary study areas were also included in the survey (Fig. 1). These were each visited on an irregular basis, although a very thorough count was made during each visit:

9. Diamond Hill, Gloucester town: This is a very prominent hill, formerly a ski area. There are a few stony trails near the summit, abandoned ski slopes, an abandoned rock quarry, and several rocky ledges and outcrops on the southern portion of the ridgeline. The habitat is dry rocky upland oak forest, containing a rich understory of blueberries and shrubs, but no wildflowers. Bearberries grow in mats on some exposed rocky areas. This was a generally poor area for butterflies during a visit in mid-May, though dusky wings (*Erynnis* spp.) were quite abundant.

10. Brown Avenue location, Snake Den State Park, Johnston: A dry weed field, bordered by homes and rich transition zone woodland.

Wildflowers were abundant, with some shrubby growth. This area was surveyed on occasion in July and August.

11. Rhode Island Community College, Warwick: An old, overgrown grassy field was found, with extensive shrubby growth and eastern red-cedar plantings. This area was visited in late May.

12. Wickabonet Wildlife Management Area, West Greenwich town: Dry, rocky upland oak forest characterizes this area. Lumbering activity has left numerous cleared areas where scrub oaks, and other young oaks grow profusely. Grasses are numerous, but virtually no wildflowers were found. This proved to be a very poor area for butterflies in mid-August. A single dusky wing was captured here.

13. Block Island, New Shoreham town: This island is characterized by a landscape of low hills and coastal "moorland" scrub vegetation. Scattered homes, small ponds, and low trees can be found across the island. A late-July trip by myself, and two later August trips by Dale Schweitzer found butterflies in fair numbers, but very few skippers.

14. Northeastern Charleston town: This area is predominantly oak woodland, with scattered areas of pitch pines. There are numerous rural residences and scattered small farm plots. A powerline cuts through a marshy area just west of Great Swamp. Reggie Webster provided most of the records from this area, for various months.

15. Galilee Bird Sanctuary marsh, Narragansett town: This tidal wetland contains an extensive stand of common reeds, bordered by thickets of rugosa rose (*Rosa rugosa*). Roadside wildflowers provide nectar sources. Although a fair number of butterflies were recorded in August, only two skippers were found.

16. Beavertail State Park, Conanicut Island, Jamestown: This area was visited during September and October to establish late-season records. The area lies at the southern tip of Conanicut Island, and is characterized by expanses of thorny coastal scrub and weedfields above high rocky coastal bluffs. Goldenrods flourish, and provide abundant nectar sources for the enormous multitude of butterflies which congregate late in the season. This area is notable for butterfly migratory activity. Surprisingly, only a single species of skipper was recorded.

17. Various other places scattered throughout the State were investigated whenever possible. Roadsides, wooded areas, open weedy places, yards, gardens, public places and parks were all observed. A log of obvious roadside sightings was kept.

Results

Skippers recorded during the 1984 survey. The typical subspecies is implied, unless another name is cited:

Silver-spotted skipper (*Epargyreus clarus* Cramer): Found in many areas throughout July and August, but was common only in Warwick and Arcadia. Adults visited milkweed and joe pye flowers.

Hoary edge (*Achalarus lyciades* Geyer): Represented by a single capture on June 20 at Warwick.

Southern cloudy wing (*Thorybes bathyllus* Smith): A few individuals were taken in open habitats from mid June to early July.

Dreamy dusky wing (*Erynnis icelus* Scudder & Burgess): Generally uncommon. Individuals were usually found perching on low vegetation or on sand along dirt roads through woodlands, but were also taken in scrubby, overgrown fields near woods. There is a single brood, from mid May to mid June.

Sleepy dusky wing (*Erynnis brizo* Boisduval & LeConte): A single specimen was recorded on May 23 at Arcadia. The individual was found resting on a sandy road through mixed oak and pine forest.

Juvenal's dusky wing (*Erynnis juvenalis* Fabricius): Generally scarce. Adults were generally found perching on low shrubs or on sand along dirt roads through woodland, or in scrubby, overgrown fields near woods. There is one brood. Records were throughout May, into early June.

Horace's dusky wing (*Erynnis horatius* Scudder & Burgess): Very uncommon in forested situations with an understory of low shrubs. Adults were usually seen perching on low shrubs or on sandy dirt roads. There were two broods, the first throughout May, the second from mid July to early August.

Persius dusky wing (*Erynnis persius* Scudder): Webster reported finding a single individual at Great Swamp on May 25.

Wild indigo dusky wing (*Erynnis baptisiae* Forbes): Numerous and widespread. Very common at Warwick and Great Swamp. Adults were usually found in sandy open areas, in close association with the larval host, wild indigo. They were also often found in a variety of dry wooded or open, scrubby places. In summer, adults nectared on the flowers of the larval host. There are two broods. The spring form flew from mid May to early June, while the summer form flew in late July and throughout August. An unusual situation was observed along the Warwick powerline. There, the normal spring and summer broods coincided with the usual flights statewide. However, an isolated flight of the summer form there, during the last week of June and into the first week of July remains a puzzle, and requires further study. This flight, though brief, comprised large numbers of adults in close association with wild indigo.

Common sooty wing (*Pholisora catullus* Fabricius): Generally scarce, found in open habitats. There are two broods. Records were for early June, and from mid July to early August.

Swarthy skipper (*Nastra lherminier* Latreille): Two small colonies were found along the Warwick powerline. A lone individual was also taken along the railroad track in eastern Coventry town. The colony habitat is extensive areas of little bluestem (*Schizachyrium scoparius*) grass, the larval host. Adults were difficult to find because of their small size, and because of their habit of flying below the tops of the grasses. No nectaring behavior was observed, despite the presence of available nectar sources. There appeared to be two broods. A single specimen was taken on July 1 (though I suspect they were more numerous), but they were fairly common in late August.

Least skipper (*Ancyloxypha numitor* Fabricius): Widespread and common in most open habitats, but especially in moist situations or near water. The adults were usually seen patrolling in weeds, but were fond of a variety of wildflowers, especially milkweed. There are two broods. The first brood individuals, from mid June until early July, were uncommon. The second brood individuals emerged in late July, and became common by mid August, with stragglers on the wing until mid September.

European skipper (*Thymelicus lineola* Ochsenheimer): Widespread and abundant in most open grassy areas. The species was equally at home in rural or urban situations. It greatly outnumbered all other butterflies in some places, especially around West Warwick, where hundreds were sighted in grassy urban lots. There was a single brood from mid June until mid July. Two specimens of form pallida Tutt, the straw-colored form, were taken in Warwick on June 20.

Leonard's skipper (*Hesperia leonardus* Harris): Found in very few open habitats, and common only at Great Swamp and in western Coventry. Adults were almost always found on joe pye flower heads. The flight period was late August to mid September.

Cobweb skipper (*Hesperia metea* Scudder): Generally uncommon, found in dry, sandy fields. The males were usually found perching on the ground or on low weeds. There was a single brood, from mid May into early June.

Indian skipper (*Hesperia sassacus* Harris): Generally scarce, found in very few open habitats. The single brood flew from late May to early July.

Peck's skipper (*Polites coras* Cramer): Numerous and widespread in both rural and urban situations. Adults were fond of wildflowers in open places. There are two broods. The first, which flew throughout June was not very numerous. The second brood, from late July to mid September was common.

Tawny-edged skipper (*Polites themistocles* Latreille): Generally scarce, usually found as lone individuals, but occasionally in small numbers. Adults were very fond of wildflowers in open habitats. There are two broods. Records were in early June and also mid July through August.

Cross line skipper (*Polites origenes* Fabricius): Found in scattered open habitats, usually in small numbers. Individuals of the single brood flew throughout July and August.

Long dash (*Polites mystic* Edwards): Found in open habitats. There were two broods. The species was most common in mid to late June, but very scarce during the second brood, from mid August to early September.

Northern broken dash (*Wallengrenia egeremet* Scudder): Taken in open habitats. Records were usually for single captures, although a few individuals have been taken together at West Warwick. Adults were fond of wildflowers. There was one brood, with flight dates ranging from mid July until early August. A single fresh individual was captured on August 24, indicating an incomplete second brood.

Little glassy wing (*Pompeius verna* Edwards): Generally scarce, found in a variety of open situations. Adults were fond of wildflowers. There was at least one full brood, with records in late June and early July. A single record on August 10 by R. Webster indicates that there may have been a partial second brood.

Delaware skipper (*Atrytone logan* Edwards): Found in small numbers in open habitats. Adults were very fond of milkweed in weedy open areas. Individuals from the single brood flew throughout July and into early August.

Mulberry wing (*Poanes massasoit* Scudder): A small colony had been discovered by Webster just west of Great Swamp, in Charlestown. Several very aged males were captured there on August 4. The habitat is a weedy wetland where the larval host, the sedge *Carex stricta*, grows. This location also supports a small colony of the black dash skipper (*Euphyes conspicua*), which often flies with *massasoit*. On August 2, a single female was captured on a joe pye flower along a woodland stream at Arcadia, far from the typical habitat.

Northern golden skipper (*Poanes bobomok* Harris): Oddly, most records were from around West Warwick, with only a single capture at Great Swamp. Individuals from the single brood flew throughout June, and were generally uncommon.

Southern golden skipper (*Poanes zabulon* Boisduval & LeConte): Several males were taken at Arcadia during late August. They visited sunlit joe pye flowers as well as those of sweet pepperbush along a woodland creek. I suspect there may be a spring brood, as the species flies in June and August on nearby Long Island, New York.

Broad-winged skipper (*Poanes viator* *zizaniae* Shapiro): This coastal skipper was closely associated with the known larval host, common reed. This tall reed grows in wet soils. Where these reeds occur in small, isolated thickets at inland

locations, *viator* was generally scarce. However, a large population was found in the extensive reed swamp at Galilee. Adults were generally found patrolling within the reed thickets or at the edges. One individual was found nectaring on pickerelweed (*Pontederia cordata*) in West Warwick. A single brood was recorded, from late July until mid August.

Black dash (*Euphyes conspicua* Edwards): A small colony was found by Webster just west of Great Swamp, in Charlestown. The habitat is a weedy wetland where the known larval host, *Carex stricta*, grows. On August 4, a small number of worn individuals were taken.

Dun skipper (*Euphyes ruricola metacomet* Harris): Found in open habitats, usually as lone individuals, but taken in numbers at Arcadia. The adults were found on a variety of wildflowers. The single brood flew from mid July to mid August.

Dusted skipper (*Atrytonopsis hianna* Scudder): An inhabitant of dry, sandy, grassy habitats, usually very scarce. This species was common along the Warwick powerline. Adults were usually found perching on the ground. The recorded flight period was very brief, in early June.

Roadside skipper (*Amblyscirtes vialis* Edwards): Represented by only two single captures along the powerline in Warwick, on June 3 and 6.

Additional records of the True Butterflies which were recorded during the 1984 survey but were not found in R.I. during the 1983 survey:

Zebra swallowtail (*Eurytides marcellus* Cramer): Friedel reported finding one stray individual of this rare visitor on his garden flowers in Warwick during July, but failed to capture it.

Pipevine swallowtail (*Battus philenor* Linnaeus): Webster reported finding one individual in Charlestown on September 12, 1983 (a previous record that is included here). This rare species reportedly utilizes ornamental pipe vines (*Aristolochia* spp.) as larval hosts in New England.

Bog copper (*Lycaena epixanthe* Boisduval & LeConte): Webster reported collecting a specimen at Great Swamp on July 1. I captured a single worn female there on July 15. Found in cranberry bogs. I suspect that 1984 flood conditions in the habitat, due to excessive spring rains, had a considerable

effect on reducing adult numbers. They are likely to be more common during favorable years.

Banded hairstreak (*Satyrium calanus falacer* Hubner): Oddly, this species was not found in 1983. During 1984, *calanus* was found in several areas of the State. It is an inhabitant of the oak forest. Though generally uncommon, this butterfly was numerous in the woods along the Trestle Trail in central Coventry. The males displayed territorial behavior on low oak boughs along sunlit trails, and were seen perching on sapling birches (*Betula* spp.) along the Trestle Trail. The single brood flew throughout July.

Olive hairstreak (*Mitoura gryneus* Hubner): Generally scarce, except in Warwick, where they were common. Adults were always found on eastern red cedar trees, the larval host. There are two broods in Rhode Island. Records were in late May to early June, and the second half of July.

Hessel's hairstreak (*Mitoura besseli* Rawson & Ziegler): One worn male was captured on wild cherry blossoms at the edge of an atlantic white-cedar stand in Great Swamp, on June 7. Another individual eluded capture. A reported flight of *M. besseli* (Webster, personal communication) at a location in Norfolk County, Massachusetts on May 13 indicates that this species may emerge as early as mid May in Rhode Island.

Hoary elfin (*Incisalia polios* Cook & Watson): A few individuals were taken in the sandy "pine barrens" habitat in Arcadia, during the latter half of May. Adults frequented bearberry mats, the known larval host.

Frosted elfin (*Incisalia irus* Godart): Generally uncommon. Colonies were found in dry, sandy, open areas where one of the larval hosts, wild indigo thrives. A lone female was captured on a lupine flower in western Coventry. The single brood flies from mid May to mid June.

Brown elfin (*Incisalia augustus croesioides* Scudder): Generally uncommon. Adults were found on bearberry mats in the "pine barrens" habitat at Arcadia, and flew with *Incisalia polios*. A few individuals were also found on bearberry mats on rocky outcrops atop Diamond Hill in Cumberland. However, adults were found in close association with huckleberry (*Gaylussacia* spp.) in western Coventry and at Great Swamp. The single brood flies from late April and throughout May.

Northern hairstreak (*Fixsenia ontario* Edwards): Webster reported capturing several individuals at Great Swamp on July 1. The adults were found nectaring on milkweed blossoms.

White M hairstreak (*Parbassius m-album* Boisduval & LeConte): Webster captured a freshly emerged male on May 6, and a female on May 18, at Great Swamp. Both were perching on low bushes along sunlit dirt roads in the oak forest. I found a female in the same general area on August 30, nectaring on a joe pye flower head.

Aphrodite fritillary (*Speyeria aphrodite* Fabricius): Generally scarce, taken only in the area around Great Swamp. Adults were found in open fields and frequented a variety of wildflowers, especially milkweeds. A male was taken on red clover (*Trifolium pratense*). There is a single brood. One early male was captured on June 19, with all other records throughout July, into early August.

Regal fritillary (*Speyeria idalia* Drury): A small isolated colony was found on Block Island, on July 20. A capture-mark-release survey on that date counted at least 46 worn males and 7 freshly emerged females. The entire colony was restricted to a small area in a larger open field, though a few individuals were found along the main roadway. Adults flew slowly, flying low and resting often, and were easily netted. Males were extremely fond of orange butterflyweed (*Asclepias tuberosa*). Often, several were seen nectaring at a single cluster of blooms. Thistles (*Cirsium* spp.) were also visited, but less often. Schweitzer provided information from two later trips, on August 16-17 and 28-29, during which he counted up to 9 males and 43 females at the same location. During the latter trip, females were reported ovipositing on a species of violet (*Viola* sp.). The flight period probably begins in early July, and lasts until mid September.

Compton tortoise shell (*Nymphalis vau-album j-album* Boisduval & LeConte): A single chrysalis was found on June 17 in Burrillville. It was attached to an outer branch (about 1 meter above the ground) of a small unidentified shrub which was stripped of its leaves by gypsy moth (*Lymantria dispar* Linnaeus) larvae. A male emerged on July 2.

Inornate ringlet (*Coenonympha tullia inornata* Edwards): The first documented capture in Rhode Island was recorded on August 16. A single fresh male was found patrolling a grassy field within sight of Interstate I-95 in West Greenwich. As the

species continues its southward range expansion into southern New England, I expect that it will become established as a breeding resident in the State. Webster reports that the species was common in two broods around Amherst, Massachusetts.

Little wood satyr (*Megisto cymela* Cramer) [sibling-species complex]: Apparently, two distinct species of *Megisto* occur in Rhode Island, here referred to as type I and type II. Both of these species are practically identical, though minor differences are evident in large series. These differences are very slight, and there is a broad overlap of characters between the two. The earlier emergence (type I) consists of slightly smaller, darker individuals. In a series, the male forewings averaged 18.4 mm from wingtip to base, and ranged from 17.0 to 19.5 mm. The females averaged 20.0 mm, ranging from 20.0 to 21.0 mm. The later emergence (type II) consists of slightly larger, lighter individuals. In a series, the male forewings averaged 19.6 mm from wingtip to base, and ranged from 19.0 to 20.5 mm. The females averaged 21.5 mm, ranging from 21.0 to 22.0 mm. Type I has been taken in a variety of habitats, all basically grassy and wooded, but with plenty of sunlight. Type II prefers more shaded woods with abundant grasses. Both species do not always fly in the same locations. Any particular area may have either type I or type II, both, or neither. The first appearance of *cymela*, which was reported at Great Swamp in 1983, was type I. The flight of each species was separated by a period of 22 days in 1983, and 19 days in 1984, during which time no *Megisto* were recorded. In 1984, type I flew during the first half of June, while type II flew throughout July and until mid August.

Acknowledgments

I am indebted to Reggie Webster, who provided a large amount of field data, informed me of a number of good locations, and who aided in the identification of several of the skippers. Thanks also to Jack Friedel and Dale Schweitzer for additional records.

Literature Cited

Little, E. L. 1980. The Audubon Society Field Guide to North American Trees (Eastern Region). New York: Alfred A. Knopf, 716 pp.

Niering, W. A. and Olmstead, N. C. 1979. The Audubon Society Field Guide to North American Wildflowers (Eastern Region). New York: Alfred A. Knopf, 864 pp.

Pavulaan, H. 1985. Field Survey of the True Butterflies (Papilionoidea) of Rhode Island. Journal of the Lepidopterists' Society 39: 19-25.

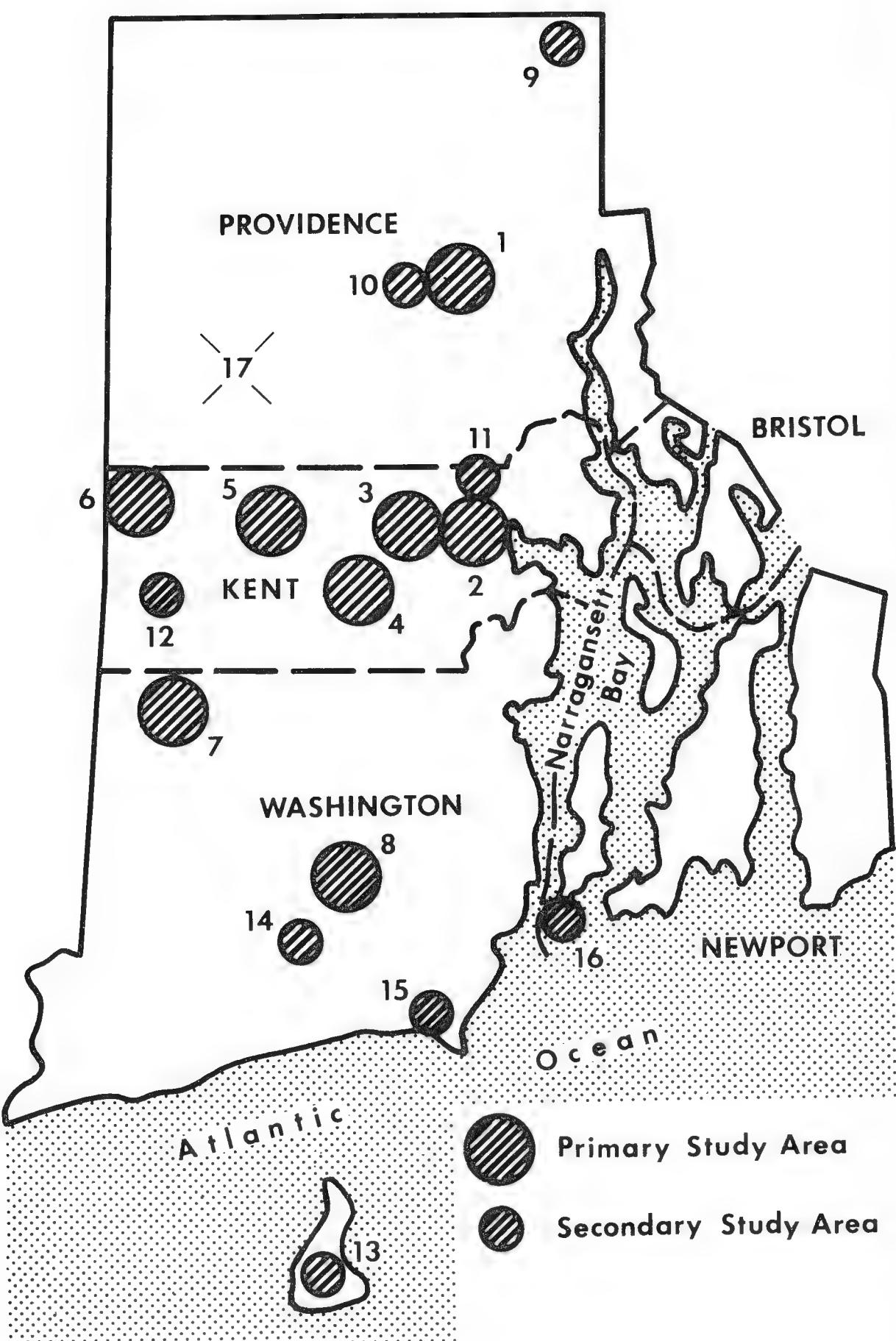


FIG. 1. Study areas for the field survey of Rhode Island butterflies, 1984.

TABLE 1: Distribution of butterflies recorded in Rhode Island during the 1984 field survey.

Table 1

HESPERIOIDEA:												
<i>E. clarus</i>	●	●	●	●								K, P, W
<i>A. lyciades</i>		●										K
<i>T. bathyllus</i>			●									K, P, W
<i>E. icelus</i>	●											K, W
<i>E. brizo</i>												W
<i>E. juvenalis</i>	●	●			●	●	●	●	●			K, P, W
<i>E. horatius</i>	●	●			●	●	●	●	●			K, P, W
<i>E. persius</i>												W
<i>E. baptisiae</i>	●	●	●	●	●	●	●					K, P, W
<i>P. catullus</i>	●		●	●								K, P, W
<i>N. lherminier</i>		●	●	●	●	●	●	●	●			K
<i>A. numitor</i>	●	●	●	●	●	●	●	●	●			K, N, P, W
<i>T. lineola</i>	●	●	●	●	●	●	●	●	●			K, P, W
<i>H. leonardus</i>	●	●	●	●	●	●	●	●	●			K, W
<i>H. metea</i>	●	●	●	●	●	●	●	●	●			K, W
<i>H. sassacus</i>	●	●	●	●	●	●	●	●	●			K, W
<i>P. coras</i>	●	●	●	●	●	●	●	●	●			K, N, P, W
<i>P. themistocles</i>	●	●	●	●	●	●	●	●	●			K, W
<i>P. origenes</i>	●	●	●	●	●	●	●	●	●			K, P, W
<i>P. mystic</i>												K
<i>W. egeremet</i>	●	●	●	●	●	●	●	●	●			K, P, W
<i>P. verna</i>			●									K, W
<i>A. logan</i>	●	●			●	●	●	●	●			K, P, W
<i>P. massasoit</i>		●	●									W
<i>P. hobomok</i>		●	●									K, W
<i>P. zabulon</i>												W
<i>P. viator</i>			●									K, W
<i>E. conspicua</i>												W
<i>E. ruricola</i>	●	●	●		●	●	●	●	●			K, P, W
<i>A. hianna</i>		●	●		●							K, W
<i>A. vialis</i>		●										K
PAPILIONOIDEA:												
<i>E. marcellus</i>												K
<i>B. philenor</i>												W
<i>L. epixanthe</i>												W
<i>S. calanus</i>	●				●							K, P, W
<i>M. gryneus</i>		●										K, W
<i>M. hesseli</i>												W
<i>I. polios</i>												W
<i>I. irus</i>		●										K, W
<i>I. augustus</i>					●	●	●	●	●			K, P, W
<i>F. ontario</i>												W
<i>P. m-album</i>												W
<i>S. aphrodite</i>												W
<i>S. idalia</i>												W
<i>N. vau-album</i>												P
<i>C. inornata</i>					●							K
<i>M. cymela I</i>			●	●	●	●	●	●	●			K, W
<i>M. cymela II</i>			●	●	●	●	●	●	●			K, P, W

Larval Hosts of Microlepidoptera of the San Bruno Mountains, California

John A. De Benedictis¹, David L. Wagner²
and James B. Whitfield³

Department of Entomological Sciences
University of California
Berkeley, CA 94720

Current addresses:

1. Department of Entomology, University of California, Davis, California 95616
2. Department of Ecology and Evolutionary Biology, University of Connecticut, Storrs, Connecticut 06268
3. Department of Biology, University of Missouri, St. Louis, Missouri 63121-4499

Abstract

The remaining undeveloped portions of the San Bruno Mountains of San Mateo Co., CA, are a refuge for two endangered butterflies and a dozen rare plants. These rare species are indicators of the vanishing Franciscan habitat of the San Francisco peninsula, an environment that harbors a moth fauna of comparable interest. As part of an on-going small moth faunal survey, an annotated list of 160 species of Microlepidoptera with their larval hosts and feeding niches is presented to summarize the approximately 700 known larval collections from the San Bruno Mountains. One recently described moth is known only from the San Bruno Mountains, and at least ten others are undescribed.

A compromise between developers and conservationists created San Bruno Mountain State and County Park, and assessments on new housing on the mountains are rehabilitating disturbed parklands and are providing critical habitat for the rare butterflies and plants. However, other park habitats have received less protection, so the mountains' diversity remains threatened.

Introduction

While much of the San Francisco peninsula was developed for residential or industrial use, approximately 1,600 ha (4000 ac) of the San Bruno Mountains of San Mateo Co., CA, remained undeveloped until recently. Today the mountains

are the largest remaining expanse of Franciscan habitat and harbor the largest extant populations of two endangered butterflies, *Callophrys (Incisalia) mossii bayensis* R. Brown and *Plebejus (Icaricia) icarioides missionensis* Hovanitz. Another indigenous butterfly, *Euphydryas editha bayensis* Sternitzky, is listed as threatened and is nearing extinction rapidly (Murphy and Ehrlich 1980).

Nearly all of the low, relatively flat region surrounding the mountains and parts of the lower slopes were developed years ago, but unstable, steep terrain and frequent cold weather likely discouraged development of most of the upper slopes and ridge tops. However, when housing prices in the San Francisco Bay area began rising dramatically, the mountains became increasingly attractive for residential development.

In the face of impending development, McClintock *et al.* (1968) published a flora of the San Bruno Mountains listing 542 species of vascular plants, 384 (71%) of which are native species. Among them are nine plants listed by the California Native Plant Society as rare and endangered and three listed as rare but not endangered. The status of the rare species of plants, insects, and other animals of the San Bruno Mountains is summarized by Orsak and Schooley (1984).

McClintock *et al.* (1968) noted several threats to some of the mountains' plants. Construction of the road traversing the mountains threatened many by altering the course of the

adjacent creek. Salt marsh plants at the southeast foot of the mountains along San Francisco Bay were jeopardized by landfill and industrial development. Other native plants were being displaced by intrusive species, the most important of which are blue gum (*Eucalyptus globulus* Labillardiere), gorse, (*Ulex europaeus* Linnaeus), brooms (*Cytisus* spp.) and several European grasses.

The greatest threat to the mountains' native biota arose in the 1970s when plans to develop much of the remaining open spaces were announced. After lengthy and costly environmental studies that challenged the integrity of the Endangered Species Act and the persistence of conservationists and the developers, a controversial compromise, the Habitat Conservation Plan (HCP), was reached. Under the HCP, 900 ha (2266 ac) of undeveloped land, including much of the habitat critical to the rare species, would be donated to the county to be preserved as a park, and much of the remaining land would be developed. Assessments on the new housing would be used to manage and restore the preserved habitat to compensate for losses of some of the critical habitat to development.

On May 10, 1986, San Bruno Mountain State and County Park was formally dedicated. Efforts are underway to restore and expand rare plant and butterfly habitat by removing some weeds, planting larval hosts and nectar sources, closing jeep trails, and excluding foot traffic through environmentally sensitive areas. The larval food plants of the rare butterflies also are being used for landscaping within the housing development.

Although it is too early to determine whether the HCP will insure the survival of the rare butterflies and plants, we believe that a potential flaw is its emphasis on the preservation of the few known rare species rather than the habitat as a whole. Arnold (1983) suggested that rare species are indicators of an ecosystem whose continued existence is threatened. The emphasis on preserving and expanding habitat for the rare species may protect some other species coincidentally, but these efforts may adversely affect others by displacing or altering their habitat. Such effects may go unnoticed because most of the mountains' fauna is poorly known.

One poorly studied group is the Microlepidoptera, so in 1980 we began a survey of the mountains by collecting moths with nets or at light and by rearing adults from larvae. Rearing

permitted us to sample areas where deployment of lights would be difficult, and enabled us to discover species which are not or are seldom attracted to light. It also provided information about immatures and larval food preferences. We summarize this information in an annotated list of 160 species of Microlepidoptera collected as larvae on the San Bruno Mountains. There may be no other Nearctic site of comparable size from which more species have been reared, and the list likely contains only about half of the resident species of Microlepidoptera of the San Bruno Mountains.

The list was compiled from about 700 records of our collections and those of a few others. For each species, we briefly describe the larval feeding niche and known hosts on the San Bruno Mountains. There are representatives of 25 families of Microlepidoptera (used here to include all moths from the primitive subfamilies through the Pterophoridae in Hedges *et al.* [1983]), among which are at least ten undescribed species. We intend to compile a complementary list of moths collected at light in the future.

The San Bruno Mountains

The San Bruno Mountains are two parallel ranges just south of San Francisco which extend northwesterly from Sierra Point on San Francisco Bay more than halfway across the San Francisco peninsula (map 1). San Bruno Mountain proper is the larger range. Its summit, Radio Peak (400 m), is near the end of Radio Road, which winds from the main entrance of the new park. For much of its length, San Bruno Mountain is separated by the Guadalupe Valley from the more northern range, the Crocker Hills. The ranges are joined by a ridge or saddle at the northern end of Colma Canyon. Except for the lower slopes, most of the previously undeveloped portions of San Bruno Mountain and the saddle lie within the park, while much of the Crocker Hills, including its summit (260 m), are slated for development.

The Franciscan habitat of most of the San Bruno Mountains is characterized by many plants adapted to the winter rain/summer drought cycle and to the thin, poor soil derived from Franciscan graywacke. Portions of three of the four plant communities of the mountains are within the park. Most prevalent are grasslands where introduced European species have displaced most native grasses or severely reduced their abundance. Dense chaparral-like coastal scrub covers large areas of the

northeast slopes and also grows in some ravines and canyons. Patches of the foothill woodland community are in the lower portions of some larger canyons. Most of the salt marsh community is distributed along San Francisco Bay, isolated from the park by a freeway and industrial development.

Microlepidoptera Larval Collection History

The earliest known collections of larval Microlepidoptera, from 1961, are those of J. A. Powell (abbreviated JAP in the appendix) of the University of California, Berkeley, who made sporadic collections during the next 25 years. P. A. Opler (PAO) collected larvae on oaks and leaf miners in 1968 and 1969 while he was a student at Berkeley studying Lepidoptera on California oaks. Powell and Opler collected larvae of about 25 species of small moths from the mountains.

The majority of collections are our own. J. B. Whitfield (JBW) collected a few species from 1980 to mid-1985, primarily to rear hymenopterous parasitoids from leaf-mining larvae. D. L. Wagner (DLW) has surveyed moths on lupines (*Lupinus* spp.), leaf miners, and hepialids, and assisted J. A. De Benedictis (JAD) in general collecting efforts from 1980 to 1987. The last collections considered here were made by De Benedictis during July 1988.

The rearing records were taken from our notes and from those held by J. A. Powell.

Most collections were made during the peak growing season from January to late July. The most frequently visited collection sites (denoted by stars in map 1) are:

1. The west-facing slope of Colma Canyon where an old trail and clearing have been invaded by native plants;
2. "Summer Seep" with an ephemeral spring;
3. The periphery of the eucalyptus grove where condensed fog drips from the trees to supplement winter rains in irrigating native plants;
4. A trail through the coastal scrub on the slope west of the industrial park in Guadalupe Valley;

5. "Manzanita Dike" near the summit where the rare species of manzanita grow at the edge of chaparral; and

6. Buckeye Canyon which contains the largest and most diverse expanse of the woodland community.

Materials and Methods

Collections were made by searching plants for the larvae or external signs of their presence such as mines, frass, or shelters. In a few instances, plants, litter, soil, or other possible larval hosts were collected because larval presence was suspected. The larvae and samples of the host were placed in plastic bags, usually one species of larva and host per bag. On warm days, bags were transported in an ice chest to the rearing site.

Most collections were reared in a enclosed trailer at the University of California, Berkeley. The larvae and host material were placed on paper towels in plastic bags. The paper towels help control the humidity, absorb condensation, and sometimes provide a pupation substrate. To minimize mold, we divided larger collections into two or more smaller rearing lots, and released excess moisture by evertting the bags periodically, by removing the contents temporarily for passive air drying, and by replacing saturated towels. Leaf miners and smaller collections sometimes were reared in smaller containers. If needed, soil or litter was provided for pupation.

Natural light entered through windows, but temperatures in the trailer were often higher than outside, and a heater maintained the minimum temperature at about 15° C. Consequently, emergences of adults sometimes were not synchronous with those in nature. Collections were inspected almost daily to appraise the condition of the larvae and their hosts and to collect emerging adults.

Results

Through August 1988, 160 species of Microlepidoptera from the San Bruno Mountains have been reared or identified from their larvae or larval mines (Table 1, Appendix). If adults were not reared, we only list species that we could identify confidently. For example, the food plant and

characteristics of the larval mines often enable identification of leaf miners to genera or species.

We avoided speculating on the specific identity of about 35 of the 160 species, but at least ten of these (perhaps as many as 20) are undescribed. *Ellabella bayensis* Heppner, known only from the San Bruno Mountains, is the only moth from our rearings that has been described as new (Heppner 1984).

The appendix lists larval collections arranged according to the check list numbers of Hodges *et al.* (1983). Unidentified and unlisted species are inserted in the approximate position they would occupy were they listed.

An asterisk following the name denotes those species other than general scavengers for which we believe host plant records have not been reported previously. Larvae of some (e.g., some of the unidentified species, *Agonopterix chrautis* Hodges, *Ellabella bayensis* Heppner, and *Ethmia albitogata* Walsingham) have been collected only on the San Bruno Mountains (larval hosts of the last two were published previously as noted in the appendix), but many of the species marked with an asterisk have been collected elsewhere in California by Powell, his associates, and ourselves, but not reported previously. New hosts are given for many other species in our list [e.g., *Dichomeris baxa* Hodges and *Plutella porrectella* (Linnaeus)], but we have not attempted to identify all the new host records.

In the appendix, the check list number (if listed) and scientific name of each species are followed by a brief description of larval feeding niche and known hosts on the San Bruno Mountains. Plant names follow McClintock *et al.* (1968). Authors of plant names are omitted to conserve space. Rearing lot numbers and the collectors' initials (as indicated in the introduction) follow each larval host.

Collectors or personnel from the Jepson Herbarium of the University of California, Berkeley, identified most of the larval food plants; most moths were identified by the collectors, J. A. Powell, and ourselves.

To conserve additional space, we have omitted emergence dates (which sometimes do not coincide with natural emergences) and the day of collection. However, the month and year of

collection are encoded in the rearing lot number. The first two digits indicate the year of collection, and the letters A-M correspond to the months January-December (with the letter "I" omitted to avoid confusing it with the numeral "1"). A few of Wagner's 1980 collections, with lot numbers beginning with the letter "L", have the month of collection embedded as a Roman numeral.

A host is listed if an adult issued from one, but not necessarily all collections of that host. The notation "no adults reared" is included only for the 23 species which were not reared from any larval collection. Several of the 23 have been collected as adults on the mountains. Larvae of a few representative species are illustrated in figures 1-10.

Miscellaneous remarks are provided for many species. They may include the means of identifying the 23 species which were not reared, brief descriptions of unidentified and undescribed moths, and explanations for discrepancies between the nomenclature of our list and that of the check list (Hodges *et al.* 1983).

More complete collection data and loans of most reared moths are available from the senior author on request.

Discussion

Faunal aspects: The 160 species that have been collected as larvae likely are about half of the Microlepidoptera of the San Bruno Mountains. This is indicated by the small proportion of moths collected at light during 1987 which have been reared (about half of nearly 70 species), by the number of unexamined or insufficiently searched hosts, and by comparisons with other California small moth surveys.

Powell (1985, unpubl. data) recorded about 330, 240, and 230 species of small moths for Santa Cruz Island, Walnut Creek in Contra Costa Co., and the Landels-Hill Big Creek Reserve in Monterey Co., respectively. Unlike our compilation, these totals include adult as well as larval collections. The Big Creek list represents only about 30 man days of collecting between 1980 and 1987, so the faunal list is expected to be much longer. Most of the Walnut Creek species were suburban blacklight collections of adults, and the total likely would increase were more larvae collected. Powell, Wagner, De Benedictis and J. F. Landry added about 90 species to the previously reported total of Santa Cruz Island

Microlepidoptera (Powell 1985) on a four-day trip to the island during which larval collecting was emphasized (Powell, unpubl. data).

On the San Bruno Mountains, the larvae were collected on about 75 of the more than 540 species of vascular plants (a few scavengers were reared from other larval hosts). We have sampled most of the more common woody plants finding no larvae on some, but many of the sampled plants have not been thoroughly examined during all seasons. Many other species have not been checked at all, especially grasses, annuals, and less abundant and introduced plants. Except for larvae in leaf shelters and leaf miners, considerable effort is needed to locate concealed feeders such as sod worms and shoot, fruit, fungus or root borers. Consequently, our list likely lacks many species in groups with many such concealed feeders such as the Cosmopterigidae, Momphidae, Sesiidae, Pyralidae and olethreutine Tortricidae, whereas the leaf-mining families, whose mines are more easily detected, are surveyed more completely.

Aside from the examples noted above, there are few other published or unpublished surveys of Microlepidoptera to compare with the San Bruno Mountains fauna, but in a 50-year survey of parts of Marshall Co. and Putnam Co., Illinois, Glenn collected 954 identified species of Microlepidoptera, 15 of which were previously undescribed (Godfrey *et al.* 1987). We estimate that the microlepidopterous fauna of the San Bruno Mountains at about 300 species, but because Glenn's survey covered an area about eight times as large as the San Bruno Mountains and with greater habitat diversity, comparing numbers of species is inappropriate. The new species (*Ellabella bayensis* Heppner) and at least ten undescribed species from the mountains are approaching the total of 15 new species from Glenn's collection, but the higher frequency of new species on the San Bruno Mountains may be more apparent than real. There are some undescribed species among the unidentified portion of Glenn's collection, and some of the undescribed species from the San Bruno Mountains may be described from specimens collected elsewhere.

The presence of undescribed species, documented range extensions, and newly discovered larval food preferences from our preliminary survey indicate that the San Bruno Mountains are a fertile site for continued investigation.

Ecological considerations: Maintaining the diversity of the microlepidopterous fauna of the San Bruno Mountains is inextricably tied to the maintenance of a diverse flora. Under the Habitat Conservation Plan (HCP), some of the funds generated by the new housing development are earmarked for preservation and recovery of habitat. These funds must be used prudently if the mountains' diversity is to be maintained.

Some of these funds are being used to remove weedy exotic plants and to reintroduce natives to disturbed sites, but many of these activities are directed towards promoting the survival of only the rare butterflies and plants. For example, when a sand-mining and refuse disposal operation inadvertently intruded into park land, a biological survey deemed the intrusion unimportant because it did not affect the rare species. A fine was levied, the activities were allowed to continue, and the dumped rubbish is later to be covered with soil and converted to rare butterfly habitat. This decision will eliminate one of the few sandy sites and its associated biota from park property.

The developers are seeking permission to grade, bench, then reconstruct what is now rare butterfly habitat across a wide area of the parklands on the steep southwest face of San Bruno Mountain to protect the impending residential development beneath it from landslides. If this is permitted and the pattern of other habitat reconstruction is followed, lupines and some other native plants will be substituted for the indigenous plants that will be graded under.

Even partial losses of widespread common plants may eliminate species of associated insects. For example, ocean spray, *Holodiscus discolor* (Pursh) Maximowicz, is the host of several species of moths on the San Bruno Mountains. Almost every plant is fed upon by larval *Adela septentrionella* Walsingham and *Epinotia johnsonana* (Kearfott), but *Eriocrania semipurpurella pacifica* Davis, whose discovery on the mountains was a significant range extension (Wagner 1985), thus far has been found on only a few plants and is absent on others just a few feet away.

Despite considerable destruction of much of the natural habitat of the San Bruno Mountains, they continue to support a rich and varied lepidopterous fauna. The endangered butterflies are only a small component of that fauna, but they and the rare plants are indicators of the rapidly disappearing

Franciscan habitat. Conservation of the San Bruno Mountains should address preservation of the entire native community, not just the few rare plants and butterflies.

APPENDIX

ERIOCRAINIIDAE

4. *Dyseriocrania auricyanea* (Walsingham). Larva: a leaf miner. Mine: a full-depth blotch along leaf margin. Host: *Quercus agrifolia*: 86F117.1 (DLW). No adults reared. Identified from larval mine.

5a. *Eriocrania semipurpurella pacifica* Davis. Larva: a leaf miner. Mine: a full-depth blotch along leaf margin. Host: *Holodiscus discolor*: 81D18, 82B3, 83D18, 83D41, 87C6 (DLW, JAD). No adults reared. Identification from mine, larvae, field-collected adults, and observed ovipositions. Wagner (1985) presented additional information about the host and range extension of this species.

HEPIALIDAE

35. *Hepialus californicus* Boisduval. Larva: a tunneler or external feeder of roots. Hosts: *Baccharis pilularis* and *Eriophyllum staechadifolium*: 81J52 (DLW). No adults reared. Identified from larvae or pupal exuvia.

36. *Hepialus hectoides* Boisduval (Fig. 9) Larva: an external feeder of roots, occasionally a borer of other woody tissue above or below ground. Hosts: *Baccharis pilularis*, *Horkelia californica*, and *Scrophularia californica*: 81J52 (DLW). No adults reared. Identified from larvae and pupal exuvia.

NEPTICULIDAE

71. *Stigmella ceanothi* (Braun). Larva: a leaf miner. Mine: an upper surface serpentine track. Host: *Ceanothus thyrsiflorus*: 81A20, 83B3, 83B51, 85C24, 88B8, 88D55.2, 88E16.1 (JAD, DLW, JBW). With the exception of the last (sp. D), the eight *Stigmella* species known from the San Bruno Mountains all form serpentine mines from which they exit to pupate in litter.

75. *Stigmella diffasciae* (Braun). Host: *Rhamnus californica*: 81A19, 83B1, 83B52, 83B67,

83C19, 85B12, 86A9, 86C19 (JAD, DLW, JBW). The specific identification is uncertain.

--. *Stigmella heteromelis* Newton & Wilkinson. Host: *Heteromeles arbutifolia*: 87C33, 87C57 (JAD). No adults reared. This recently-described species (Newton and Wilkinson 1982) was identified from the larval mine.

100. *Stigmella variella* (Braun). (Fig. 1). Host: *Quercus agrifolia*: 68B37, 86F117.2 (PAO, DLW). No adults reared. Identified from mine.

---. *Stigmella* sp. A*. Host: *Mahonia pinnata*: 68C38, 69C99 (PAO, JAP). Adults are dark brown with a white submarginal band. This undescribed species is known from several other northern California localities. It will be fully described and named by D. R. Davis in a monograph in preparation.

---. *Stigmella* sp. B*. Host: *Rhamnus californica*: 83B23, 86A9 (JAD, DLW). The larva can be found with *S. diffasciae* on the same plants, but is less abundant. The forewing is dull black with a single indistinct submarginal band. The moth is larger than *S. diffasciae* and emerges earlier under our rearing conditions.

---. *Stigmella* sp. C*. Host: *Salix lasiolepis*: 86F115 (DLW). No adults reared. This species, reared elsewhere, was identified from its mine.

---. *Stigmella* sp. D*. Mine: an upper surface blotch covering the entire leaf. Host: *Rhamnus crocea*: 87A2 (JAD). No adults reared. Identified from the larval mine.

TISCHERIIDAE

150. *Tischeria splendida* Braun. Larva: a leaf miner. Mine: a gradually expanding elongate blotch, silk within mature mines often induces the leaf to fold over and conceal the mine. Host: *Rubus ursinus*: 68B35, 85F7, 85F24 (JAD, PAO).

152. *Tischeria confusa* Braun. Host: *Fragaria californica*: 85F18, 85G2, 85G10, 88F91 (JAD). Biology similar to that of *T. splendida*. The coloration and genitalia of this moth differ somewhat from Braun's (1972) description and illustration of those of *T. confusa*.

167. *Tischeria ceanothi* Walsingham. Larva: a leaf miner. Mine: an elongate blotch with the

epidermal surface above the mine initially light gray, darkening later. Host: *Ceanothus thyrsiflorus*: 82L21, 83B4, 86F130, 87B151, 88B8.1, 88C12.3, 88D55, 88E16.1 (JAD, DLW).

INCURVARIIDAE

221. *Adela septentrionella* Walsingham. Host: *Holodiscus discolor*: 85C52 (JAD). The larval feeding niche was not observed. An adult emerged from a collection of leaf litter. Powell (1969) has speculated on the larval feeding habits.

HELIOZELIDAE

253. *Coptodisca saliciella* (Clemens). Larva: a leaf miner. Mine: a full-depth blotch. Host: *Salix lasiolepis*: 87F116 (DLW). No adults reared. The larva, from within the mine, cuts an oval from the upper and lower surfaces of the mined leaf, then ties them together, descends from the mine, and spins a cocoon on lower stems or leaves or in litter using the excised ovals as the outer layer. The mines with the small holes cut by the descended larvae were used to identify this species.

TINEIDAE

402. *Tinea niveocapitella* Chambers. Larva: a detritivore of animal matter. Hosts: Bushtit's nest in *Holodiscus discolor*: 83B24 (DLW); owl and/or hawk "pellets" (regurgitated, partially digested prey): 86C15.1 (JAD, DLW). The biology of the next species is similar. Adults of both species emerged from the bird pellets over a three month period. The last adults to emerge were half the size of the first possibly due to deterioration of the quality of the food.

403. *Tinea occidentella* Chambers. Host: Owl and/or hawk "pellets": 86C15 (JAD, DLW).

LYONETIIDAE

466. *Bedellia somnulentella* (Zeller). Larva: a miner of one or more leaves. Mine: initially a sinuous hairline track, later a full-depth blotch. Hosts: *Convolvulus* sp.: 83C34, 83C45, 83F2 (JAD, JBW). *Convolvulus subacaulis*: 86F127 (JAD, DLW).

475.1. *Paraleucoptera heinrichi* Jones. Larva: a gregarious leaf miner, exiting to pupate beneath a opaque white hammock-like silken tent on the under surface of a leaf. Mine: a full-depth

blotch along leaf margin. Host: *Prunus ilicifolia*: 83D2, 84B63 (JAD, JAP).

505. *Bucculatrix variabilis* Braun. Larva: initially a leaf miner, later skeletonizes small patches on upper or lower leaf surfaces. Mine: a short serpentine track. Host: *Baccharis pilularis*: 82B24, 82C33, 82E56, 83E4.1, 84C9, 86C13 (JAD, DLW, JBW). There are three species of *Bucculatrix* known from *B. pilularis* in northern California. There were no adult emergences from some of the above lots and including them under this species is arbitrary. One of ten moths from lot 86C13 resembled *Bucculatrix separabilis* Braun, but its identity is unconfirmed. The biologies of the other *Bucculatrix* species recorded from San Bruno Mountain are similar. (Other species, not yet collected on San Bruno Mountain, are full-term leaf miners or gall formers.)

---. *Bucculatrix* n. sp.*. Host: *Baccharis pilularis*: 83D71, 83D77 (JAD, JBW). The forewings are gray with a narrow white longitudinal stripe extending from the wing base to the end of the discal cell. It is larger than *B. variabilis*. Its cocoon is pinkish. It is known from other coastal California localities.

550. *Bucculatrix albertiella* Busck. Host: *Quercus agrifolia*: 86F117.7 (DLW). No adults reared. Identified from mine.

576. *Bucculatrix ceanothiella* Braun. Host: *Ceanothus thyrsiflorus*: 88B8.2, 88C12, 88D55, 88E16 (JAD).

GRACILLARIIDAE

585. *Caloptilia agrifoliella* Opler. (Fig. 7). Larva: concealed in an elongate leaf roll of new foliage. Hosts: *Quercus agrifolia*: 86C37, 86F117.3, 88C16.1 (JAD, DLW); *Q. wislizenii*: 86F117.3 (DLW). The *Caloptilia* species recorded from San Bruno Mountain feed within a blotch mine for the first three instars, exit to construct one or two feeding shelters, then pupate in translucent oval cocoons. Only the last feeding shelter of each species is described.

602. *Caloptilia diversilobiella* Opler. Mature larva concealed within a leaf roll with pinched ends. Host: *Rhus diversiloba*: 81H17.5, 82E77 (JAD, DLW).

621. *Caloptilia palustriella* (Braun). (Fig. 9). Larva within a somewhat conical or pyramidal shelter. Host: *Salix lasiolepis*: 83E21, 86D121, 86F113, 88E6 (JAD, DLW).

628. *Caloptilia reticulata* (Braun). Larva within a triangular shelter formed by folding the leaf tip to the midrib and securing it with silk. Hosts: *Quercus agrifolia* and *Q. wislizenii*: 86F117.4 (DLW).

---. *Caloptilia* n. sp.*. Larva within a somewhat conical or pyramidal leaf roll in new foliage. Host: *Umbellularia californica*: 86F119 (DLW). No adults reared. This species, reared elsewhere, was identified by the larval feeding shelter.

---. *Acrocercops* n. sp.*. Larva: a leaf miner. Mine: a full-depth blotch, bubble-like when mature. Host: *Solidago canadensis*: 87C7 (JAD, DLW). Forewings are pale gray with white strigulae along the costal margin.

716. *Marmara salictella* Clemens. Larva: a miner of green twig or trunk bark. Mine: an elongate serpentine track. Host: *Salix lasiolepis*: 86C62 (DLW). No adults reared. Identified from mine.

---. *Marmara* sp. (Fig. 3). Larva: a miner of stem epidermis. Mine: an extremely elongate serpentine tract. Host: *Rubus ursinus*: 82B2 (DLW). No adults reared. Identified to genus by its mine.

721. *Cremastobombycia grindeliella* (Walsingham). Larva: a leaf miner. Mine: a lower surface blotch (younger instars), tentiform (last two instars). Hosts: *Anaphalis margaritacea*: 82B43, 82L22, 86A8 (JAD, DLW); *Gnaphalium chilense*: 82L23 (DLW); *Gnaphalium* sp.: 82B36 (DLW). The specific identification is uncertain.

731. *Phyllonorycter apicinigrella* (Braun). Larva: a leaf miner. Mine: a lower surface blotch (younger instars), blister-like later. Host: *Salix lasiolepis*: 83F7, 85E111 (JAD, JBW). The larval biologies of the other *Phyllonorycter* species are similar, but the mines differ somewhat in shape and surface textures.

756. *Phyllonorycter holodisci* (Braun). Host: *Holodiscus discolor*: 83G72, 86D123 (JAD, DLW). No adults reared. Identified from larval mine.

760. *Phyllonorycter inusitatella* (Braun). Host: *Quercus agrifolia*: 86F117.6 (DLW). No adults reared. Identified from the larval mine which distinguishes it from other *Phyllonorycter* species on this oak.

---. *Phyllonorycter* sp. Host: *Symporicarpos albus* var. *laevigatus*: 82C2, 83B5, 83C38, 83D45, 83E3, 84F26, 85F9, 86D118.1 (JAD, DLW, JBW). Forewing pattern varies, but generally with four white, often incomplete, outwardly-arched fasciae transecting the golden-brown ground. The inner (basal) margin of each fascia is separated from the ground by a patch of black scales in the costal half of the wing and by a smaller black patch along the caudal margin. Most of the apical margin of the wing at the base of the fringes is black.

806. *Cameraria agrifoliella* (Braun). Larva: a leaf miner. Mine: an upper leaf surface blotch with one to three creases at its periphery. Host: *Quercus agrifolia*: 68B36, 86F117.6, 87A9 (JAD, PAO, DLW). No adults reared. Identified from larval mine.

---. *Phyllocnistis* n. sp.*. Larva: a leaf miner. Mine: a glossy white serpentine track on the upper or lower surface of a new leaf. Host: *Prunus ilicifolia*: 81H17, 83F1, 84D39, 86D134.1, 86F122 (JAD, DLW, JBW). Forewings are white with a pale orange patch near the apex, a black postapical spot in the cilia, a heavy dusting of gray-brown scales in the caudal half, and four complete or incomplete gray-brown chevrons in the distal part of the wing and postapical cilia. This undescribed species is known from other San Francisco Bay Area localities.

OECOPHORIDAE

861. *Agonopterix oregonensis* Clarke. Larva: a skeletonizer from under a silken web or from within a leaf roll. Hosts: *Sanicula arctopoides*: 86C8, 87C35 (JAD, DLW). *Sanicula crassicaulis*: 86C8.1 (JAD, DLW). *Sanicula bipinnatifida*: 86D12 (JAD). Early instars sometimes tunnel into the leaves of the succulent *Sanicula* species.

870. *Agonopterix fusciterminella* Clarke. Larva: a full depth leaf miner initially, usually feeding externally from concealment within a rolled leaf later. Host: *Senecio aronicoides*: 86D3, 87C56 (JAD, DLW). Published records of *Cynoglossum grande* as a larval host of this species (Clarke 1941, Hodges 1974), are almost certainly erroneous. Although *Cynoglossum* is stated as the host on paratypes of this species collected by Keifer in Marin Co., CA, the

host was likely misidentified. When growing in shady places such as where *Cynoglossum* grows, leaves of *Senecio aronicoides* are easily confused with those of *Cynoglossum*. In several San Bruno Mountain and other California collections of *Cynoglossum*, including plants growing alongside *Senecio* being fed upon by larval *Agonopterix*, we have only found larvae of *Udea itysalis marinensis* Munroe and *Caloreas apocynoglossa* Heppner.

871. *Agonopterix chrautis* Hedges*. Larva: concealed in a crimped or folded leaf edge on the upper surface. Host: *Ligusticum apiifolium*: 84E28, 86B4, 87D16-D16.1 (JAD).

872. *Agonopterix sabulella* (Walsingham). Larva: concealed in a rolled fascicle of leaflets, especially beneath developing flowers. Hosts: *Eriophyllum staechadifolium*: 82C32, 83C20, 88A1 (JAD); *Eriophyllum confertiflorum*: 83D8 (JAD).

874.1. *Agonopterix alstroemeriana* (Clerck). Larva: concealed in a rolled tube of leaflets, usually on newer leaves. Host: *Conium maculatum*: 86D1, 86E12 (JAD). This introduced Palearctic species was first recorded in California at Berkeley in 1982 (J. A. Powell, unpubl. data).

904. *Exaeretia thoracefasciella* (Chambers). Larva: a leaf miner or concealed skeletonizer in a web of silk over either or both leaf surfaces. Host: *Sidalcea malvaeflora*: 68B34, L2-III-80, 83B63, 83C39, 85A3, 86B5, 87A13, 88A38 (JAD, PAO, DLW, JBW). The generic placement follows Becker (1984).

968. *Ethmia albitogata* Walsingham. Larva: an external feeder on flowers. Host: *Amsinckia lunaris*: 63E1 (JAP). No adults reared. Identified by the larvae and by collections of adults near the food plant earlier in the season. Powell (1971) described the larvae from this collection. The collection site was destroyed by housing development in 1986.

ELACHISTIDAE

---. *Coelopoeta* n. sp.*. Larva: a leaf miner. Mine: an elongate blotch which is concealed by silk within the mine inducing the leaf to curl. Host: *Phacelia californica*: 62D3, 81D24, 81D29, 81D42, 81E37, 82B1, 86B6, 86C16, 86D124, 88B17 (JAD, JAP, DLW). The forewing of this undescribed species is brown, powdered with white scales, and with a white caudal margin and triangular tornal patch. It

also is known from other coastal localities and from the Sierra Nevada.

1077. *Onceroptila cygnodiella* (Busck)*. (Fig. 2). Larva: a leaf miner, sometimes mining more than one leaf. Mine: a full-depth blotch. Host: *Symporicarpos albus* var. *laevigatus*: 82D63, 84F27, 86D118 (JAD, DLW). This species also mines *Symporicarpos mollis* on San Bruno Mountain, but we made no collections.

BLASTOBASIDAE

----. *Holcocera* sp. A. Larva: a scavenger, often concealed in abandoned shelters of other Lepidoptera larvae. Hosts: *Ceanothus thyrsiflorus*: 88B8.3, 88D55.3 (JAD); *Eriogonum latifolium* (dry flowers): 88A39 (JAD); Bushtit's nest in *Holodiscus discolor*: 83B34 (DLW). Forewings of the adult are gray and white with a broken dark gray band at the end of the discal cell and a dark gray mid-costal spot. The biology of the next species is similar. The generic placement of both is unconfirmed.

----. *Holcocera* sp. B. Host: Leaf litter beneath *Rhamnus californica*: 85B12 (JAD, DLW). The forewings are dull brown with the basal third pinkish tan.

----. *Blastobasinae*. The biology is similar to that of *Holcocera*. Host: Leaf litter beneath *Rhamnus californica*: 85B12 (JAD, DLW). The forewings are glossy, dark chocolate-brown. These have been identified to subfamily only.

COLEOPHORIDAE

1289. *Coleophora accordella* Walsingham. (Fig. 5). Case: stubby, turbin-shaped, camouflaged by shaggy leaf fragments incorporated into the outer surface. Host: *Lotus scoparius*: 86D117 (JAD, DLW). Except for the subfamily Batrachedrinae (whose inclusion in the family is not followed by many authorities), all North American coleophorids are in the genus *Coleophora* Hubner. Many species are undescribed or difficult to identify. Each species constructs a larval case from silk and debris of distinctive shape and texture which can be useful for identification. We describe the cases of the reared species and two others that have been reared on the San Bruno Mountains. All of these species attach one end of the case to a leaf, mine a circular patch, then move on to another leaf or another area of the same leaf. Other species feed on flowers or seeds, and some do not mine.

1317. *Coleophora viscidiflorella*

Walsingham. Case: thin, smooth, conical, with the proximal end often bent. Host: *Baccharis pilularis*: 82B25, 83D76, 83E4, 83E24, 86C14, 86D6 (JAD, DLW). Some of these records may refer to *Coleophora* sp. D (below). Both have cases of similar size, surface texture, and shape, but careful studies may reveal differences that we did not detect. The third species on the San Bruno Mountains that feeds on *Baccharis*, *C. lynosyridella* Walsingham, is easily identified by its case.

1320. *Coleophora lynosyridella*

Walsingham. Case: long, slender, smooth, cylindrical, with the distal end splayed and flattened. Host: *Baccharis pilularis*: 88D15 (JAD). No adults reared. Identified from the larval case using Tilden's (1954) descriptions of the *Coleophora* spp. on *Baccharis*.

----. *Coleophora* sp. A.*

Case: pistol-shaped. Host: *Salix lasiolepis*: 83F3, 85E7, 88D51 (JAD). The forewing is whitish basally, gradually darkening to gray in the distal half.

----. *Coleophora* sp. B.*

Case: a long, thin, rough-surfaced cone. Host: *Monardella villosa*: 82E64, 82E85, 83C44, 83E10, 83E72 (JAD, DLW). Forewings are pearly white with a light dusting of tan scales.

----. *Coleophora* sp. C.*

Case: an elongate, thin, rough-surfaced cone. Host: *Holodiscus discolor*: 81D17, 86D122 (DLW). The forewings are entirely pale gray.

----. *Coleophora* sp. D.*

Case: short, smooth, conical, with the proximal end somewhat bent. Host: *Baccharis pilularis* 88D14 (JAD). The forewings are pale yellow-brown with two faint narrow ocherous longitudinal lines and with brown along most veins. Not included in Tilden's (1954) study of coleophorids on *Baccharis*.

----. *Coleophora* sp. E.

Case: very short, smooth, fusiform. Host: *Artemisia californica*: 88D54 (JAD). No adults reared.

1403. *Batrachedra salicipomonella*

Clemens. Larva: a tunneler of leaf galls of *Pontania pacifica* (Hymenoptera: Tenthredinidae). Host: Galls on *Salix lasiolepis*: 85H59 (JAD).

MOMPHIDAE

----. *Mompha* sp. A.* Larva: a pith borer of stems. Host: *Epilobium* sp.: 88F93 (JAD). The forewing is dark violet-brown with blue-gray blotches, two patches of raised black-tipped scales, and a narrow white submarginal band distad of which is a small white spot with a blue-gray center. The dorsum of the thorax and head is dark violet-brown. It was collected with the next species. Larvae were found from the root crown to stem tips, but we did not determine if larvae of either or both species fed only in certain sections of the stem. The last adult of this species emerged ten days before the first adult of the next issued. There are many significant genitalic differences between the two species.

----. *Mompha* sp. B.* Host: *Epilobium* sp.: 88F93.1 (JAD). The forewing is dark brown with the base and caudal third brownish orange, with the brownish orange extending to the costal margin obliquely submarginally and almost to the costal margin near the middle of the wing, and with the two patches of raised scales within these markings. A narrow white submarginal band transects the wing immediately distad of these markings. The dorsum of the head and thorax is brownish orange.

COSMOPTERIGIDAE

1550. *Anoncia orites* (Walsingham)*. Larva: initially a full-depth miner, later a concealed skeletonizer in two or more silk-tied, overlapping leaves. Host: *Monardella villosa*: 82E66, 82E83-4, 83C41, 83E9, 87D11 (JAD, DLW). The pregenital abdominal sclerites of the San Bruno Mountains specimens are less modified, but otherwise the genitalia are very similar to preparations and illustrations of other *A. orites* specimens (Hodges 1978).

1593. *Stilbosis dulcedo* (Hodges). Larva: a leaf miner. Mine: a full-depth blotch covered on both surfaces by frass ejected from the mine. Hosts: *Quercus agrifolia* and *Q. wislizenii*: 86F117.8 (DLW). No adults reared. Identified from larval mine.

1615. *Walshia miscecolorella* (Chambers). Larva: a tunneler of woody stems beneath the bark. Host: *Lupinus arboreus*: 78B1 (JAP).

1633. *Sorhagenia nimbosa* (Braun). Larva: initially a concealed skeletonizer in a folded and silk-tied new leaf which enlarges, distorts and hardens

later to resemble a gall. Host: *Rhamnus californica*: 83E27, 84F20 (JAD).

SCYTHRIDIDAE

----. *Scythris* sp. Larva: a miner of one leaf or adjacent leaves; mine concealed by a silken tube along the rachis. Hosts: *Anaphalis margaritacea*: L13-II-80, 80C22, L33-VI-80, 82B48, 82D64, 86A8.3 (JAD, DLW); *Gnaphalium* sp. (or *Anaphalis*?): 68C40, 69C97, 80B2, 81C13, 84C23, 84C24.1, 84C25, 85C47, 88B18 (JAD, PAO, JAP, DLW). Forewings are black with a narrow white, often broken longitudinal stripe near the middle. Powell (1976a) characterized the larva from rearing lot 69C97.

GELECHIIDAE

1730. *Aristotelia argentifera* Busck. Larva: a concealed foliage feeder in a silken tube spun along the axis of a shoot, often within silk-tied terminal leaves. Host: *Baccharis pilularis*: 83E23 (JAD).

1782. *Recurvaria francisca* Keifer. Larva: a leaf miner. Mine: a full-depth discolored blotch with one to four digitate channels extending toward the petiole. Host: *Ceanothus thyrsiflorus*: 80C24, 81D25, 85C24, 88C12.2, 88D55.5, 88E16.3 (JAD).

----. *Coleotechnites* sp. *. Larva: a concealed skeletonizer in frass-fouled silken tubes within a rolled-under leaf margin or sometimes between overlapping leaves. Hosts: *Heteromeles arbutifolia*: 84B66, 86C92, 87A8, 87C31 (JAD, JAP); *Prunus ilicifolia*: 82E72 (JAD). The forewing is gray with a narrow black band extending down the center of the wing from the apical margin for 3/4 of its length then arching to the costal margin and with a narrow black band transecting the wing obliquely near the base. The generic assignment is uncertain.

1859. *Telphusa sedulitella* (Busck). Larva: a concealed foliage feeder in silk-tied young leaves. Host: *Quercus agrifolia*: 86C35.1, 88C16.2 (JAD).

1904. *Arla diversella* (Busck). Larva: a concealed foliage feeder in silk-tied leaflets. Host: *Lotus scoparius*: 83C33, 84D38, 85C46, 86D126 (JAD).

1918. *Rifseria fuscotaeniella* (Chambers) *. Larva: a leaf miner. Mine: a full-depth blotch. Host: *Anaphalis margaritacea*: L13-II-80, 82B48, 82D64,

84C31 (JAD, DLW); *Gnaphalium* sp.: 82B36, 82C1 (DLW).

1972. *Gnorimoschema baccharisella* Busck. (Fig. 6). Larva induces a gall in which it feeds. Gall: varies from fusiform to globular, subterminal. Host: *Baccharis pilularis*: 83E25, 84F22, 84F46 (JAD).

----. *Gnorimoschema* sp. A. *. Larva: a borer of terminals. Host: *Solidago spathulata*: L7-III-80, 86C17, 86C33.1, 88C19 (JAD, DLW). Forewings are gray with black steaks and 4-6 small patches of raised black scales. The genitalia are very similar to those of *G. gallaesolidaginis* (Riley), a eastern, gall-forming species. This species is undescribed.

----. *Gnorimoschema* sp. B. *. Larva induces a gall in which it feeds. Mature gall: globular, on the central stem close to the ground. Hosts: *Aster* sp.: 88G21 (JAD); *Solidago canadensis*: 88A5, 88C17, 88E1, 88G23 (JAD). The forewings are rich chocolate to violet brown sometimes with faintly indicated thin white submarginal and basal oblique bands. D. Povolny, Institute of Agriculture, Brno, Czechoslovakia, is describing and naming this species from specimens reared from *Aster* galls collected by Powell in Marin Co., CA.

2017. *Scrobipalpula lutescella* (Clarke). Larva: a stem tip borer. Hosts: *Castilleja wightii*: 82D5, 82D57, 83C32, 84C5 (JAD, DLW); *Castilleja* sp.: 68C44, 83F8 (PAO, JBW). Although the male and female genitalia are very similar to those of *S. lutescella*, the wing pattern differs somewhat, so this may be a related species.

2020. *Scrobipalpula potentella* (Keifer). Larva: a leaf miner. Mine: a full-depth blotch in one or more leaves (leaves often tied with silk and distorted). Host: *Horkelia californica*: 85B14, 85C8, 85C21, 86B7, 86D10 (JAD, DLW, JBW).

----. *Scrobipalpula "psilella"-group* sp. A. *. Larva: a leaf miner. Mine: a full-depth blotch. Hosts: *Anaphalis margaritacea*: L33-VI-80, 82B43, 82B48 (JAD, DLW); *Gnaphalium chilense*: 82L24 (DLW); *Gnaphalium* sp.: 81C13, 82D59, 84C24, 85D1 (JAD, JAP). According to Povolny, who will describe this species, this moth has genitalic similarities to *S. psilella* (H.-S.), a Palearctic species. The forewings are pale gray, irrorated with darker scales and with bronze-colored streaks along the veins.

----. *Scrobipalpula "psilella"-group* sp. B.* Larva: a leaf miner. Mine: a full-depth blotch. Host: *Chrysopsis villosa* var. *bolanderi*: 87D3, 87D9 (JAD). Similar to the preceding species except that the ground color of the forewings and body is much darker.

2039. *Symmetrischema striatella* (Murtfeldt). Larva: concealed in one or more rolled leaves. Hosts: *Solanum furcatum*: 86A7, 86F131, 88A36 (JAD, DLW); *Solanum nodiflorum*: 86L76 (JAD).

----. *Ptycerata* sp.* Larva: a shoot tip borer that ties terminal leaves. Host: *Artemisia californica*: 83C30, 83E11, 85A5, 85B4, 85C48 (JAD). This pale gray moth with darker streaks resembles a species from specimens reared elsewhere on *A. californica* that will be described by D. Povolny.

----. *Scrobipalpa* sp. A.* Larva: a concealed leaf skeletonizer in a rolled leaf margin. Host: *Artemisia douglasiana*: 82E76, 83E29, 85E112, 86D128, 87D17 (JAD). The forewings of this moth are reddish to rusty brown and peppered with darker scales. Povolny will describe this species from specimens collected elsewhere.

----. *Scrobipalpa* sp. B.* Larva: a leaf miner. Mine: a full-depth blotch. Host: *Solidago canadensis*: 87C53, 88C17.1 (JAD, DLW). The forewing is charcoal gray. The generic determination needs confirmation.

2047. *Keiferia lycopersicella* (Walsingham). Larva: a concealed foliage feeder in one or more rolled leaves. Host: *Solanum umbelliferum*: 85B5 (JAD).

2065. *Chionodes braunella* (Keifer). Larva: a concealed leaf skeletonizer in silk-tied adjacent leaflets. Hosts: *Lupinus albifrons*: L1-III-80 (DLW); *Lupinus variicolor*: L20-II-80, 80C23, 84D37 (JAD, DLW); *Lupinus* sp.: 82C31, 87A10 (JAD).

2067. *Chionodes ceanothiella* (Bsk.). Larva: a concealed foliage and flower feeder in tied-leaves or flowers. Host: *Ceanothus thyrsiflorus*: 85C24, 88B4, 88C12.4 (JAD).

2068. *Chionodes chrysopyla* (Keifer). Larva: a concealed foliage feeder in silk-tied new leaves. Host: *Quercus agrifolia*: 86C35.2, 88C16.3 (JAD).

2070. *Chionodes dammersi* (Keifer). Larva: a concealed foliage feeder in a frass-fouled silken tube in a rolled dry leaf. Host: *Eriogonum latifolium*: 82B42, 83B64, 83D4, 86C34, 87A11-A11.1, 87D7, 88C4, 88D2 (JAD).

----. *Chionodes* sp. A.* Larva: a concealed foliage feeder in a silken web near the center of the leaf. Host: *Sidalcea malvaeflora*: 85A3 (JBW). The forewing is black with an incomplete, white submarginal line. The dorsal surfaces of the head and thorax are white. It probably is undescribed.

----. *Chionodes* sp. B.* Larva: likely a scavenger. Hosts: *Eriogonum latifolium*: 82B42 (JAD); *Lupinus arboreus*: L31-II-80, 84C30.2 (DLW); owl or hawk "pellets": 86C15.2 (JAD, DLW); *Phacelia californica*: 86D115.1; *Solidago spathulata*: 86C33.2 (JAD). The larval feeding niche is inferred from the diversity of larval hosts. The narrow forewings are brown or rusty-brown with dark brown blotches.

2141. *Filatima demissae* (Keifer). Larva: a concealed foliage feeder in a frass-fouled silken tube in a necrotic area of a fully hardened leaf. Host: *Prunus ilicifolia*: 82E72, 83E6, 86F129 (JAD, JBW). Keifer (1932) collected the types in Sonoma Co., CA, on *Prunus demissa*, but in the San Bruno Mountains it has not been found on that plant, even those growing adjacent to its host.

----. *Filatima* sp. Larva feeds in silk-tied leaves and flowers. Host: *Ceanothus thyrsiflorus*: 88D55.6, 88E16.4 (JAD). The adult has dark chocolate brown forewings with scattered black spots.

----. *Aroga* sp. A.* Larva: a concealed foliage-feeder in a frass-fouled silken tube in a rolled dry leaf. Host: *Eriogonum latifolium*: 63F9, 82E81, 83E77, 83F5, 85E11, 85F19 (JAD, JAP). Occupies the same feeding niche as *Chionodes dammersi* (see above), which it replaces later in the year. Forewings are buff-brown with numerous black longitudinal streaks especially along the veins radiating from the discal cell. Its genitalia resemble those of *A. eldorada* (Keifer), a much darker moth that feeds on *Artemisia douglasiana*.

----. *Aroga* sp. B.* Larva: a concealed foliage feeder in a flimsy silken tube at the base of a floral shoot or in basal leaves. Host: *Eriogonum latifolium*: 82B42 (JAD). The forewing is black with a white submarginal line and inner margin. Dorsal

surfaces of the head and thorax are white. It resembles, and may be, *A. unifasciella* (Busck).

2221. *Syncopacma nigrella* (Chambers). Larva: a concealed leaf skeletonizer in a tear drop-shaped bundle of silk-tied leaflets. Hosts: *Lupinus albifrons*: L12-II-80, L19-II-80, L5-VI-80, 87C36 (JAD, DLW); *Lupinus chamissonis*: L30-II-80, L20-VI-80 (DLW); *Lupinus variicolor*: L32-II-80, L4-VI-80 (DLW).

2239. *Anacampsis lacteosochrella* (Chambers)*. Larva: a concealed foliage feeder in silk-tied rolled leaves. Host: *Croton californicus*: 87A6 (JAD).

----. *Dichomeris baxa* Hodges. Larva: a concealed foliage and flower feeder in silk-tied leaves and floral bracts. Host: *Chrysopsis villosa* var. *bolanderi*: 86F128 (JAD, DLW). This species was recently described (Hodges 1986).

COPROMORPHIDAE

----. *Ellabella bayensis* Heppner. Larva: a concealed flower and foliage feeder in a tightly rolled leaf or webbed flower. Host: *Mahonia pinnata*: 81D36, 81D41, 82D55, 82D61, 83D9, 83D67, 85D2, 85D66 (JAD). This species was described by Heppner (1984). It was known previously from a single specimen collected by Opler. De Benedictis (1984) transferred the genus to Copromorphidae (Copromorphoidea) from Plutellidae (Yponomeutoidea). The species is known only from the San Bruno Mountains.

PLUTELLIDAE

2350. *Eucalantica polita* (Walsingham). Larva: a concealed feeder of flowers or, occasionally, leaves in a loose web of silk. Host: *Vaccinium ovatum*: 81D32, 82B46, 84E31, 85C23 (JAD, JBW).

2351. *Euceratia castella* Walsingham. Larva: initially tunnels leaf buds, later an external foliage-feeder. Host: *Syphoricarpos albus* var. *laevigatus*: 83C22.1, 85C2, 85C22 (JAD, JBW).

2363. *Plutella porrectella* (Linnaeus). Larva: a concealed foliage feeder in rolled leaf apices or a flat web on the underside of a leaf. Host: *Barbarea orthoceras*: 86A6 (JAD). This species was first noted in California at San Bruno Mountain and is thought to be introduced (Powell 1967b). This is the first record of its feeding on a native plant.

2366. *Plutella xylostella* (Linnaeus). Larva: a concealed feeder of leaves, buds and flowers in a loose mass of silk. Host: *Erysimum franciscanum*: 66D10 (JAP). The larval host is one of the mountains' endangered plants.

2372. *Ypsolopha cervella* (Walsingham). Larva concealed in silk-tied young leaves. Host: *Quercus agrifolia*: 88C16.5 (JAD). No adults reared. Identified from the larva and cocoon.

----. *Ypsolopha* sp. Larva: a concealed feeder of flowers and leaves in silk-sealed bracts. Host: *Mahonia pinnata*: 83D111 (JAD). Forewings are tawny. It may be *Y. rubrella* (Dyar), described from Colorado where it feeds on another species of *Mahonia*.

ARGYRESTHIIDAE

2453. *Argyresthia francisella* Busck. Larva: a miner of silk-tied needles. Host: *Cupressus macrocarpa*: 84C28 (JAD, DLW).

2482. *Argyresthia trifasciae* Braun. Larva: a miner of silk-tied needles. Host: *Cupressus macrocarpa*: 84C28 (JAD, DLW).

----. *Argyresthia* sp.* Larval feeding niche uncertain. Host: *Salix lasiolepis*: 83C40, 86C23 (JAD, DLW). The forewings are dark brown with a brownish-yellow caudal margin. The larva was in a collection of new shoots with apical leaves. It likely bored into the shoot tip.

SCHRECKENSTEINIIDAE

Note: Kyrki (1984) removed the genus *Schreckensteinia* from Yponomeutoidea on the basis of adult characters. Minet (1983) proposed that the family Schreckensteiniidae be reapplied to the genus and placed it in a new superfamily Schreckensteinioidea. The pupae of both species in the San Bruno Mountains are well-spined and protrude from the cocoon when adults emerge. These are uncharacteristic of the Yponomeutoidea and Heliodinidae, in which the genus is listed in Hodges *et al.* (1983).

2508. *Schreckensteinia felicella* (Walsingham). Larva: a tunneler of buds, later an external skeletonizer. Hosts: *Castilleja affinis*: 82E75 (JAD); *Castilleja wightii*: 82C29, 82E58, 85F17, 85G1 (JAD); *Castilleja affinis* & *C. wightii*: 83E26, 83F8, 87D18 (JAD, JBW).

2509. *Schreckensteinia festaliella* (Hubner). Larva: a leaf skeletonizer. Host: *Rubus ursinus*: 84E30, 84F24, 85F4 (JAD).

CHOREUTIDAE

2634. *Caloreas apocynoglossa* Heppner. Larva: a skeletonizer concealed beneath a silken web on leaf under surfaces. Host: *Cynoglossum grande*: 88B47.1.

2647. *Tebenna gnaphaliella* (Kearfott). Larva: a tunneler of leaf bases or a concealed skeletonizer in a flat web on the under surface of a leaf; often gregarious. Hosts: *Anaphalis margaritacea*: L33-VI-80, 82B48, 86A8.1 (JAD, DLW); *Gnaphalium* sp.: 69C98, 80B2, 82B35.5, 82B48 (PAO, JAP, DLW).

TORTRICIDAE

2738. *Endothenia hebesana* (Walker). Larva: a concealed feeder of carpels and seed in silk-tied senescent flowers. Host: *Castilleja wightii*: 85F17, 85G1 (JAD).

2976. *Phaneta pallidarcis* (Heinrich). Larva: a borer in green shoot tips. Host: *Artemisia californica*: 88D53 (JAD).

2984. *Phaneta artemisiana* (Walsingham). Larva: a stem tip borer. Host: *Gnaphalium* sp.: 83D1 (JAD).

3102. *Eucosma williamsi* Powell. Larva: a tunneler of the root crown or woody tissue just above it. Host: *Baccharis pilularis*: 82A9.5, 82A10 (DLW).

3289. *Epinotia johnsonana* (Kearfott). Larva: a concealed foliage feeder in a silk-tied, folded leaf. Host: *Holodiscus discolor*: 82D60, 82D62, 83D43, 86D4 (JAD).

3297a. *Epinotia cupressi* Heinrich. Larva: a concealed needle feeder in silk-tied needles. Host: *Cupressus macrocarpa*: 84C28, 84E29 (JAD). Brown (1980) considers this to be a valid species rather than a subspecies of *E. hopkinsana* (Kearfott) as in Hodges *et al.* (1983).

3322. *Epinotia sagittana* McDunnough. Larva: a concealed feeder of flowers and new leaves in silk-tied flowers or leaves. Hosts: *Grossularia*

californica: 88B49 (JAD); *Ribes malvaceum*: 85A1, 87A12 (JAD).

3323. *Epinotia emarginana* (Walsingham). Larva concealed in a rolled young leaf or among two or more silk-tied leaves. Host: *Quercus agrifolia*: 86C35, 88C16 (JAD).

3324. *Epinotia columbia* (Kearfott). Larva: a concealed foliage feeder in tied terminals or a rolled leaf. Host: *Salix lasiolepis*: 81D45, 83C40, 83E22, 85E8, 86C23.1, 86C100, 88C3.1, 88E5, 88E7 (JAD). The last collection was a larva that bored into and fed within a sawfly gall on a green shoot. Brown (1980) removed this species from synonymy with *E. crenana* (Hubner), which he considers to be a distinct, Palearctic species.

3326. *Epinotia bigemina* Heinrich. Larva: concealed in and feeding on tied terminal leaves, buds and flowers. Hosts: *Arctostaphylos imbricata*: 82E69, 83D74 (JAD); *A. montaraensis*: 81D35, 82E70 (JAD). The larval hosts are endangered plants.

3328. *Epinotia arctostaphylana* (Kearfott). Larval biology similar to that of *E. bigemina* (above). Hosts: *Arctostaphylos imbricata*: 81D33-D34, 82E69, 83E73 (JAD); *A. montaraensis*: 82E70, 83E74 (JAD).

3331. *Epinotia infuscana* (Walsingham). Larva: a tunneler of terminal shoots and floral rachis (both hosts) or in the bark (*L. arboreus*). Hosts: *Lupinus albifrons*: L16-II-80 (DLW); *L. arboreus*: L15-II-80 (DLW).

3342. *Epinotia lomanana* (Kearfott). Larva: concealed foliage feeder in initially a folded leaf, later, a rolled leaf. Hosts: *Prunus ilicifolia*: 86D134 (JAD); *Rhamnus californica*: 86E4 (JAD). The *Rhamnus* collection was a prepupal larva. The plant is probably not a true larval host.

3363. *Ancylis simuloides* (McDunnough) *. Larva: a concealed feeder of tied new leaves. Host: *Ceanothus thyrsiflorus*: 80C24, L6-III-80, 81D25, 85C24, 88C12.1, 88D55.1 (JAD, DLW).

3437. *Grapholita lunatana* Walsingham. Larva: a concealed leaf skeletonizer in silk-tied overlapping leaves. Host: *Vicia gigantea*: 83E75, 85F8, 86D127, 88E14 (JAD). No adults reared. Identified by association of adults with larval host. It

has been reared from *Vicia* elsewhere. Larvae construct several shelters.

3440. *Grapholita edwardsiana* (Kearfott). (Fig. 4). Larva: a tunneler of small living or, rarely, dead shoots. Host: *Lupinus arboreus*: 78B1, L14-II-80, L28-II-80, 84C30.1 & 30.2, 87A5 (DLW, JAD, JAP). In 1978, this moth was proposed for threatened status, but phenetic studies suggest that it and *G. lana* (Kearfott) are conspecific (Wagner, unpubl. data). Currently, its listing is no longer under consideration.

3475. *Cydia cupressana* Kearfott. Larva: a borer in cones. Host: *Cupressus macrocarpa*: 87A4, 87C34 (JAD).

3531. *Acleris bastiana* (Linnaeus). Larva: a concealed foliage feeder in silk-tied rolled or overlapping leaves. Host: *Salix lasiolepis*: 87F1 (JAD).

3535. *Acleris keiferi* Powell. Larva: a concealed foliage feeder in a silk-tied folded leaf or between overlapping leaves. Host: *Rubus ursinus*: 84F25, 85F2, 86E1 (JAD).

3541. *Acleris senescens* (Zeller). Larva: a concealed foliage feeder in tied apical leaves or a rolled leaf. Host: *Salix lasiolepis*: 81D47, 84E19, 86E14 (JAD).

3566. *Cnephasia longana* (Haworth). Larva: a leaf miner or stem borer initially, later an external feeder on flowers or, rarely, foliage. Hosts: *Collinsia franciscana*: 83E7 (JAD); *Convolvulus* sp.: 87D8 (JAD); *Eriogonum latifolium*: 82E81 (JAD); *Rumex* sp.: 88D4 (JAD); *Scrophularia californica*: 87D13 (JAD); *Vicia americana*: 87D10 (JAD); *Wyethia angustifolia* 87D14 (JAD). We collected this polyphagous species on several other plant species. Only the collections where adults were reared are listed.

3574. *Decodes fragarianus* (Busck). Larva: a concealed feeder of silk-tied young leaves. Host: *Quercus agrifolia*: 86C35.3 (JAD).

----. *Decodes asapheus* Powell. Larva: a concealed foliage feeder in silk-tied leaves. Host: *Grossularia californica*: 87B152.1 (JAD). The adults closely match the type series of this recently described species from King City, Monterey Co., CA, reared from *Ribes aureum* (Powell 1980).

3612. *Argyrotaenia franciscana* (Walsingham). Larva: a concealed feeder of leaves, buds and flowers in rolled, folded and tied leaves or flowers. Hosts: *Aesculus californica*: 86D2 (JAD); *Arctostaphylos imbricata*: 82E69 (JAD); *Baccharis pilularis*: 66C13, 84C8 (JAD, JAP); *Castilleja affinis*: 82E80 (JAD); *Castilleja* sp.: 81D38 (JAD); *Ceanothus thyrsiflorus*: 81D25 (JAD); *Cupressus macrocarpa*: 87A4.1 (JAD); *Eriogonum latifolium*: 83D3, 85C25, 88D3 (JAD); *Eriophyllum staechadifolium*: 82B53 (JAD); *Fragaria californica*: 88B15 (JAD); *Gnaphalium* sp.: 82B51 (JAD); *Grindelia* sp.: 88D1.1 (JAD); *Horkelia californica*: 85B14 (JAD); *Lupinus arboreus*: 84C30.1 (DLW); *Mahonia pinnata*: 83D66, 85B2 (JAD); *Monardella villosa*: 83C43 (JAD); *Quercus agrifolia*: 88C16.4 (JAD); *Rhamnus californica*: 82B50, 86B8 (JAD); *Ribes malvaceum*: 87A12.2 (JAD); *Rubus ursinus*: 85F2, 88A3 (JAD); *Salix lasiolepis*: 88C3 (JAD); *Scrophularia californica*: 86C9.1 (JAD); *Solidago spathulata*: 86C33 (JAD); *Symporicarpos albus* var. *laevigatus*: 82C25 (JAD); *Vaccinium ovatum*: 84E31 (JAD, JBW).

3680. *Clepsis fucana* (Walsingham). Larva: a concealed foliage feeder in a silk-tied folded or rolled leaf. Hosts: *Anaphalis margaritacea* or *Gnaphalium* sp.: 68C39, 83C14 (JAD, PAO); *Fragaria chiloensis*: 83B69 (JAD); *Gnaphalium* sp.: 88C18 (JAD); *Horkelia californica*: 85B14, 85C21 (JAD, JBW); *Marah oreganus*: 86C6 (JAD); *Phacelia californica*: 86B1 (JAD); *Scrophularia californica*: 83C13, 86C9 (JAD); undetermined adventive South African Boraginaceae: 81D40, 82B44 (JAD).

3714. *Sparganothis senecionana* (Walsingham). Larva: a leaf roller, especially of low-growing plants. Hosts: *Achillea millefolium* var. *californica*: 66E11 (JAP); *Anaphalis margaritacea* or *Gnaphalium* sp.: 68C39 (PAO); *Lupinus albifrons*: L18-II-80 (DLW); *Phacelia californica*: 61E1 (JAP).

3749. *Amorbia cuneana* (Walsingham). Larva: a concealed foliage feeder in silk-tied overlapping leaves. Hosts: *Prunus ilicifolia*: 84B64 (JAP); *Heteromeles arbutifolia*: 87C32 (JAD).

3770. *Henricus macrocarpana* (Walsingham). Larva: a borer of cones. Host: *Cupressus macrocarpa*: 86A4.2 (JAD).

----. *Saphenista* sp.* Larva: a tunneler of developing flowers from subtending silk-tied leaflets. Host: *Eriophyllum staechadifolium*: 82C32, 84E24,

85F5 (JAD).. The forewing is pale gray with a black band from the discal cell to the caudal margin. This may be the species listed in Hodges *et al.* (1978) as *Phalonidia latipunctana* (Walsingham), which M. G. Pogue (unpubl. Ph.D. studies) reassigned to *Saphenista*. Pogue's generic assignments also are applied to the next two species. The "Cochylidae" now are considered a tribe, Cochylini, of the Tortricinae.

3780. *Saphenista saxicolana* (Walsingham). Larva concealed within silk-tied flowers. Host: *Ceanothus thyrsiflorus*: 88C12.5, 88E16.5 (JAD).

3793. *Trachysmia aegrana* (Walsingham). Larva: a tunneler of the root crown. Host: *Eriophyllum staechadifolium*: 72C5 (JAP).

PYRALIDAE

5052. *Pyrausta californicalis* (Packard). Larva: a concealed foliage feeder in loosely-tied leaves. Host: *Monardella villosa*: 82E67 (DLW).

5054. *Pyrausta dapalis* (Grote). Larva: concealed within flowers or external on leaves (*Salvia*), or concealed within a loose bundle of silk-tied leaves (*Monardella*). Host: *Monardella villosa*: 61B18, 81B16, 83E8, 83E71 (JAD, JAP); *Salvia spathacea*: 81C16, 81D39, 84C4 (JAD).

5060. *Pyrausta subsequalis petaluma* Munroe. Larva: a stem borer. Host: *Cirsium* sp.: 86D133 (JAD).

5064. *Pyrausta perrubralis* (Packard) *. Larva concealed in silk-tied leaves or in flowers. Host: *Monardella villosa*: 88F92 (JAD).

5074. *Pyrausta fodinalis fodinalis* (Lederer). Larva: a concealed foliage feeder in loosely-tied leaves. Host: *Monardella villosa*: 61B17, 61C2, 83C41, 83C42, 83D5 (JAD, JAP).

5099i. *Udea itysalis marinensis* Munroe. Larva: a concealed feeder of silk-tied flowers or in silk-tied rolled leaves. Host: *Cynoglossum grande*: 87C44, 88B47 (JAD).

5695. *Trachycera caliginella* (Hulst). Larva: a concealed foliage feeder in a frass-fouled fascicle of silk-tied leaves. Host: *Quercus agrifolia*: 68B38 (PAO). No adults reared. Identified from

larvae and their shelter. The generic placement follows Neunzig (1986).

PTEROPHORIDAE

6109. *Platyptilia carduidactyla* (Riley). Larva: a borer of stem tips and floral receptacles. *Cirsium* sp.: 83C15 (JAD).

6112. *Platyptilia williamsii* Grinnell. Larva: a borer of stem tips and floral receptacles or, rarely, an external feeder. Hosts: *Anaphalis margaritacea*: 82B48 (JAD, DLW); *Artemisia douglasiana*: 81C14, 82C26, 83E28 (JAD); *Erigeron glaucus*: 81D26, 81E34 (JAD); *Eriophyllum confertiflorum*: 84E25 (JAD); *E. staechadifolium*: 82E78, 84E24 (JAD); *Gnaphalium* sp.: 68C40, 82D59, 83C14, 84C23, 84F47 (JAD, JAP); *Grindelia* sp.: 86D131, 88A6, 88C18.1, 88D1 (JAD, DLW); *Senecio aronicoides*: 81E35, 14-V-81 (JAD); unidentified composite: 84C27 (JAD).

6117. *Anstenoptilia marmorodactyla* (Dyar). Larva: a borer of inflorescences and stems. Hosts: *Monardella villosa*: 83C41, 88E15.2 (JAD); *Salvia spathacea*: 81D39, 84E26 (JAD).

6118c. *Amblyptilia pica cratea* (T. B. Fletcher). Larva: initially a borer in shoot terminals, later an external feeder of leaves. Hosts: *Scrophularia californica*: 87C40 (JAD); *Stachys* sp.: 87C41 (JAD).

6130. *Stenoptilodes albiciliata* (Walsingham). Larva: a borer of inflorescences. Hosts: *Castilleja affinis*: 82E80 (JAD); *C. wightii*: 85F17 (JAD); *C. affinis* & *C. wightii*: 83E26 (JAD); *Castilleja* sp.: 82D5, 83F8 (DLW, JBW). Early season specimens look like the nominate subspecies; later ones resemble the subspecies *S. a. rubricans* which Lange (1950) described from Monterey and San Mateo counties.

6170. *Oidaematophorus phaceliae* McDunnough. (Fig. 10). Larva: an external feeder of stems and flowers or leaf skeletonizer. Hosts: *Phacelia californica*: 86D115, 88C14 (JAD, DLW); *P. malvaefolia*: 86D132 (JAD).

6182. *Oidaematophorus confusus* Braun. Larva: an external foliage-feeder. Host: *Baccharis pilularis*: 81D27, 83D79, 84C9 (JAD).

6189. *Oidaematophorus phoebus* Barnes & Lindsey *. Larva: a leaf and stem borer feeding

externally in its last instar. Hosts: *Anaphalis margaritacea*: 61C5, L33-VI-80, 82B48, 86A8.4 (JAD, JAP, DLW); *Gnaphalium* sp.: 80B2, 85B13 (JAD, JAP, DLW). The specific identification is uncertain.

6234. *Emmelina monodactyla* (Linnaeus). Larva: an external feeder of stems, leaves and flowers. Host: *Convolvulus subacaulis*: 86F126 (JAD, DLW).

Acknowledgments

We thank Jerry A. Powell of the Department of Entomological Sciences, University of California, Berkeley, for his sizable contribution to this paper. Dr. Powell identified many of the moths that we collected, suggested potential larval hosts, reviewed various drafts of the manuscript, and shared his knowledge of the San Bruno Mountains with us. We greatly appreciate receiving his larval collection records and those of Paul A. Opler, Department of the Interior, U. S. Fish and Wildlife Service, Fort Collins, CO, for inclusion in this paper. Dr. John F. Emmel of Hemet, CA, studied the life histories of the butterflies of the San Bruno Mountains while in medical school at the University of California, San Francisco. The lasting impression from his highly informative presentation of his studies at the 1972 meeting of the Pacific Slope Branch of the Lepidopterists' Society in Oakland, CA, inspired the selection of the mountains as a study site by demonstrating that this nearby locality was rich in biological information. We thank David A. Christy of the Parks and Recreation Division, San Mateo County Department of Environmental Management, for issuing collecting permits and Chief Ranger Ron Weaver and his staff for their cooperation and assistance while at the mountain park. David Schooley of Bay Area Mountain Watch, a non-profit conservationist group that monitors the San Bruno Mountains, informed us of the past and planned activities of the county and developers which affect the future of the mountains. H. K. Sharsmith and John Strother of the Jepson Herbarium, University of California, Berkeley; Elizabeth McClintock of the California Academy of Sciences, San Francisco; and Peter Rubtzoff of the Department of Entomological Sciences, University of California, Berkeley, identified several of the larval food plants. John W. Brown, University of California, Berkeley, and Stephen Passoa, University of Illinois, Urbana, provided many suggestions for improving this paper in their reviews of the manuscripts. National Science Foundation grant GB-6813X in part supported larval collections

by Powell and Opler from 1968-1970, and grant BSR-8411459 provided partial support for the collection and curatorial activities of De Benedictis and Wagner from 1985 to 1988.

Literature Cited

Arnold, R. A. 1983. Ecological studies of six endangered butterflies (Lepidoptera, Lycaenidae): Island biogeography, patch dynamics, and the design of habitat preserves. *Univ. Calif. Publ. Entomol.* 99:1-161.

Becker, V. O. 1984. Taxonomic notes on the Neotropical Microlepidoptera. *Rev. Bras. Entomol.* 28:129-201.

Brown, R. L. 1980. A revision of the genus *Epinotia* (Hubner) (Tortricidae: Eucosmini). Part 1. The North American species of the *stroemiana* lineage. PhD dissertation, Cornell University, Ithaca, N.Y., (unpubl.)

Clarke, J. F. G. 1941. Revision of the North American moths of the family Oecophoridae, with descriptions of new genera and species. *Proc. U. S. Nat. Mus.* 90 (3107):33-286.

De Benedictis, J. A. 1984. On the taxonomic position of *Ellabella* Busck, with descriptions of the larva and pupa of *E. bayensis* (Lepidoptera: Copromorphidae). *J. Res. Lepid.* 23:74-82.

Godfrey, G. L., E. D. Cashatt and M. O. Glenn. 1987. Microlepidoptera from the Sandy Creek and Illinois River Region: An annotated checklist of the suborders Dacnonypha, Monotrysia, and Ditrysia (in part) (Insecta). Illinois Natural History Survey, Champaign, IL, special publication 7. 44 p.

Heppner, J. B. 1984. Revision of the Oriental and Nearctic genus *Ellabella* (Lepidoptera: Copromorphidae). *J. Res. Lepid.* 23:50-73.

Hodges, R. W. 1974. *Gelechioidea: Oecophoridae* (in part). In: Dominick, R. B., T. Dominick, D. C. Ferguson, J. G. Franclemont, R. W. Hodges and E. G. Munroe (eds.). *The Moths of America North of Mexico*, fasc. 6.2, x + 142 p, 1 monochrome and 7 color pl. E. W. Classey, Ltd., and R. B. D. Publications, London.

Hodges, R. W. 1978. *Gelechioidea* (in part): *Cosmopterigidae*. In: Dominick, R. B., et al. (eds.) *The Moths of America North of Mexico*, fasc. 6.1., x + 167 p., 6 pl. E. W. Classey, Ltd., London and the Wedge Entomological Foundation, [Washington, D.C.].

Hodges, R. W. 1986. *Gelechioidea: Gelechiidae* (in part). In: Dominick, R. B., et al. (eds.) *The Moths of America North of Mexico*, fasc. 7.1, xii + 196 p.. The Wedge Entomological Research Foundation, Washington, D.C.

Hodges, R. W., T. Dominick, D. R. Davis, D. C. Ferguson, J. G. Franclemont, E. G. Munroe and J. A. Powell (eds.). 1983. *Check List of the Lepidoptera of America North of Mexico Including Greenland*. xxiv + 161 p. E. W. Classey, Ltd., London, and The Wedge Entomological Research Foundation, [Washington, D.C.].

Keifer, H. H. 1932 ("1931"). California Microlepidoptera. V. (Gelechiidae). Pan-Pac. Entomol. 8:61-74.

Keifer, H. H. 1936. California Microlepidoptera. IX. Calif. Dep. Agric. Bull. 25:235-259.

Kyrki, J. 1984. The Yponomeutoidea: A reassessment of the superfamily and its constituent suprageneric groups (Lepidoptera). Entomol. Scand. 15:71-84.

Lange, W. H. 1950. Biology and systematics of plume moths of the genus *Platyptilia* in California. Hilgardia 19:561-668.

McClintock, E., W. Knight and N. Fahy. 1968. A flora of the San Bruno Mountains, San Mateo County, California. Proc. Calif. Acad. Sci. (4th ser.). 32:587-677.

Minet, J. 1983. Etude morphologique et phylogénétique des organes tympaniques des Pyraloidea. I. Generalités et homologues (Lep. Glossata). Ann. Soc. Entomol. Fr. (new ser.) 19:175-207.

Murphy, D. C. and P. R. Ehrlich. 1980. Two California checkerspot butterfly subspecies: one new, one on the verge of extinction. J. Lepid. Soc. 34:316-320.

Neunzig, H. H. 1986. *Pyraloidea: Pyralidae* (in part). In: Dominick, R. B., et al. (eds.), *The Moths of America North of Mexico*, fasc. 15.2, vi + 113 p. The Wedge Entomological Research Foundation, Washington, D.C..

Newton, P. J. and C. Wilkinson. 1982. A taxonomic revision of the North American species of *Stigmella* (Lepidoptera: Nepticulidae). Syst. Entomol. 7:367-463.

Orsak, L. and D. E. Schooley. 1984. San Bruno Mountain. Pac. Discovery 37(4):4-9.

Powell, J. A. 1969. A synopsis of Nearctic adelid moths, with descriptions of new species (Incurvariidae). J. Lepid. Soc. 23:211-240.

Powell, J. A. 1971. Biological studies on moths of the genus *Ethmia* in California (Gelechioidea). J. Lepid. Soc. 25 (suppl. 3):1-67.

Powell, J. A. 1976a. A remarkable new genus of brachypterous moth from coastal sand dunes in California (Lepidoptera: Gelechioidea, Schythrididae). Ann. Amer. Entomol. Soc. 69:325-339.

Powell, J. A. 1976b. *Plutella porrectella* (L.) in California. Pan-Pac. Entomol. 43:89-91.

Powell, J. A. 1980. A synopsis of *Decodes* (Lepidoptera: Tortricidae), with descriptions of new species and a related new genus in Mexico. Pac. Insects 22:78-114.

Powell, J. A. 1985. Faunal affinities of the Channel Islands Lepidoptera: A preliminary overview, p. 69-94 in: *Entomology of the California Channel Islands* (ed. by A. S. Menke and D. R. Miller). Santa Barbara Mus. Nat. Hist., Santa Barbara, CA. 178 p. + 8 maps.

Tilden, J. W. 1954. Microlepidoptera associated with *Baccharis pilularis*. III. Aegeriidae, Coleophoridae. Wasmann J. Biol. 12:43-52.

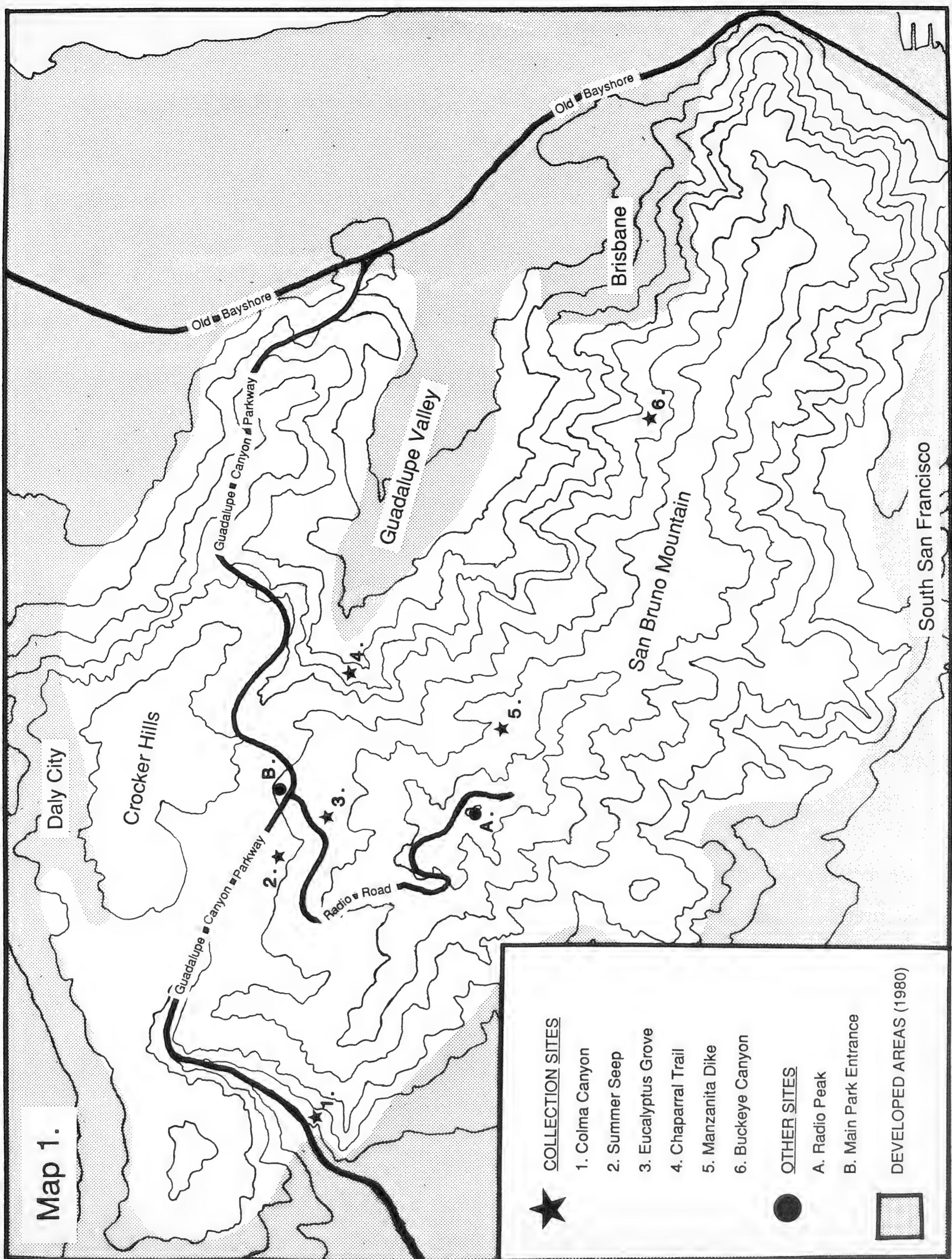
Wagner, D. L. 1985. First California record and confirmation of a rosaceous host for *Eriocrania* (Lepidoptera: Eriocraniidae). J. Lepid. Soc. 39:60-61.

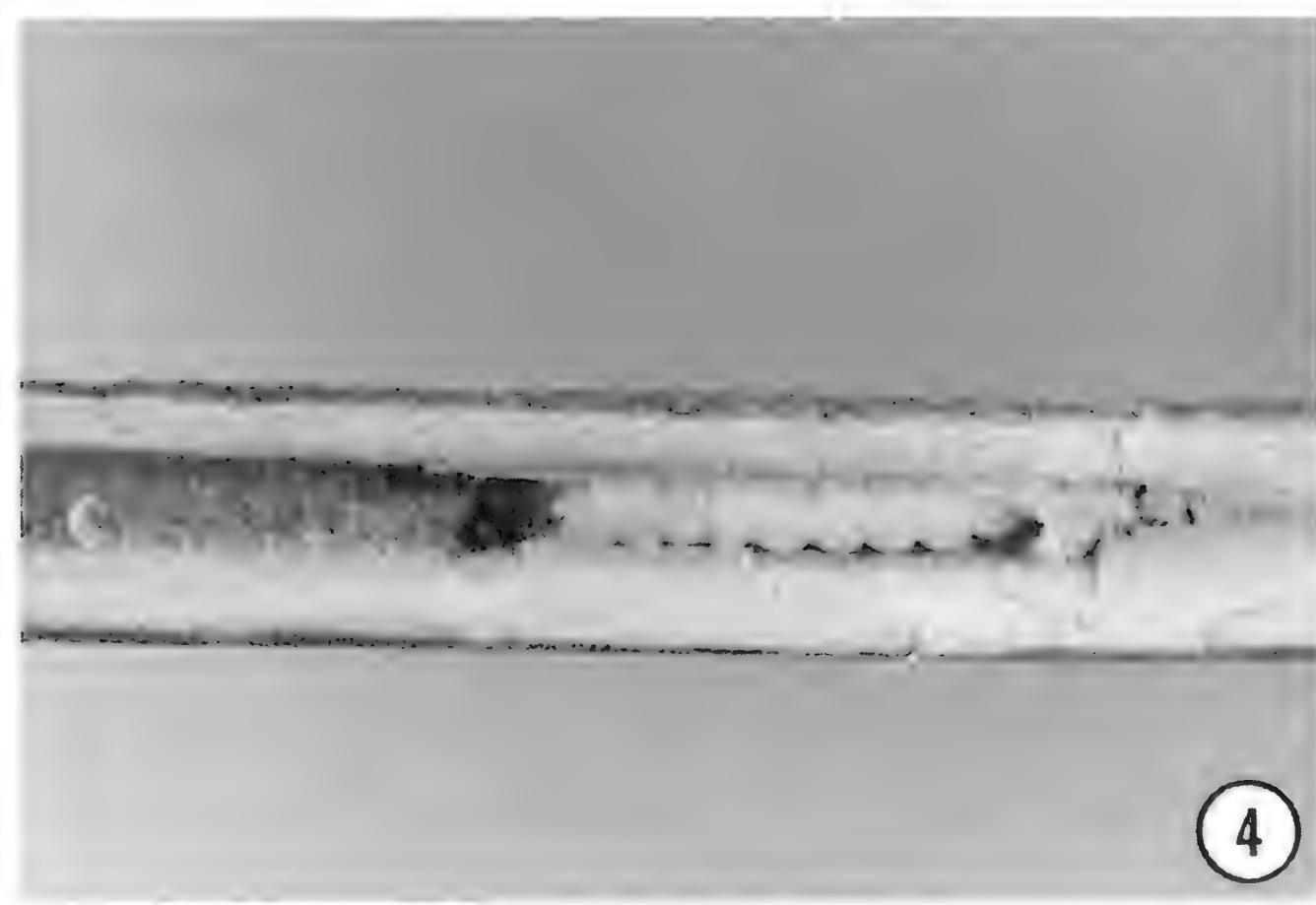
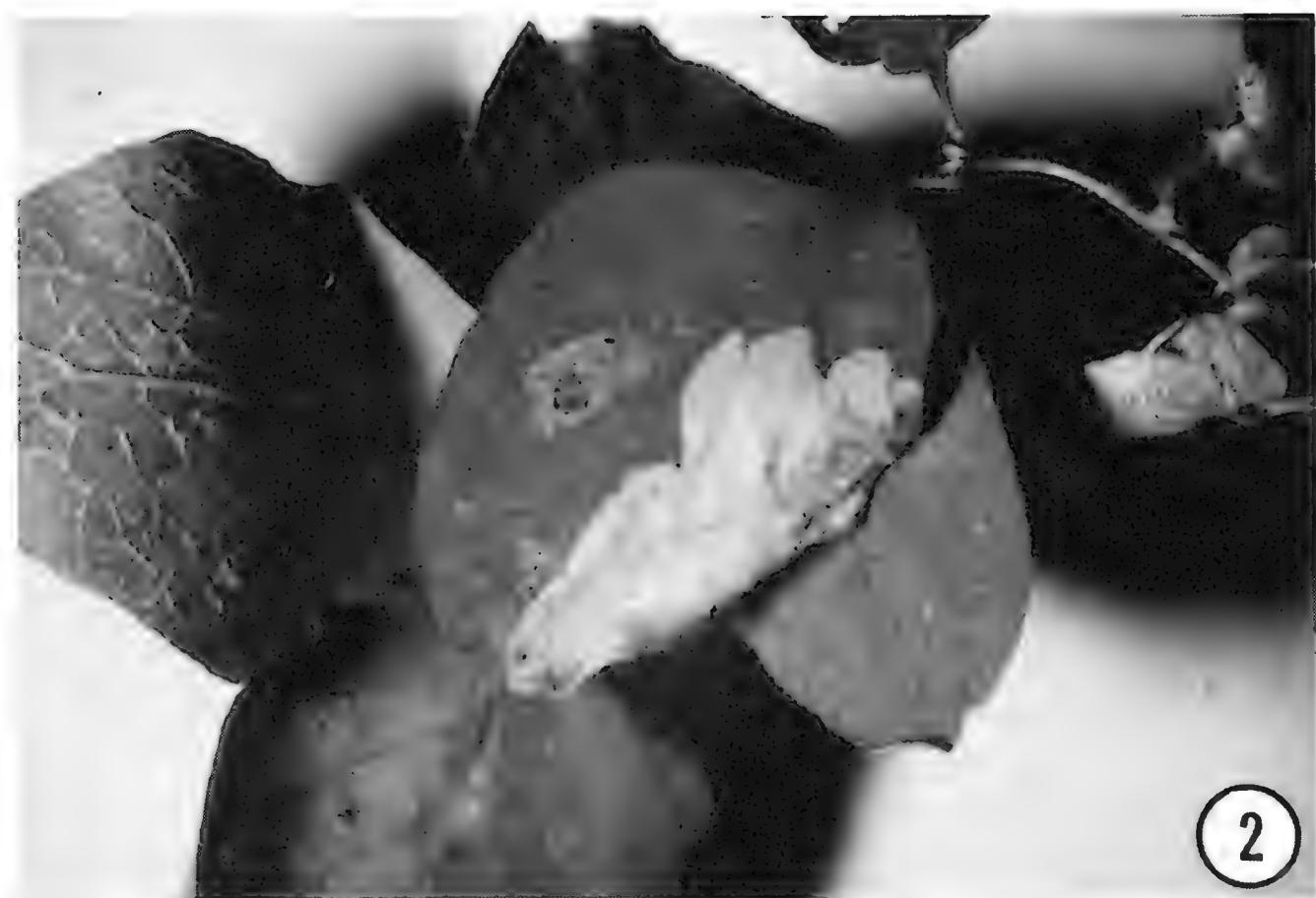
**Table 1: SAN BRUNO MOUNTAIN MICROLEPIDOPTERA
LARVAL COLLECTIONS**

<i>SPECIES</i>			<i>SPECIES</i>		
<i>FAMILY</i>	<i>TOTAL</i>	<i>REARED</i>	<i>FAMILY</i>	<i>TOTAL</i>	<i>REARED</i>
Eriocraniidae	2	0	Momphidae	2	2
Hepialidae	2	0	Cosmopterigidae	4	3
Nepticulidae	8	4	Scythrididae	1	1
Tischeriidae	3	3	Gelechiidae	31	31
Incurvariidae	1	1	Copromorphidae	1	1
Heliozelidae	1	0	Plutellidae	6	5
Tineidae	2	2	Argyresthiidae	3	3
Lyonetiidae	6	5	Schreckensteiniidae	2	2
Gracillariidae	15	9	Choreutidae	2	2
Oecophoridae	7	6	Tortricidae	31	30
Elachistidae	2	2	Pyralidae	7	6
Blastobasidae	3	3	<u>Pterophoridae</u>	9	9
Coleophoridae	9	7			

Total Species: 160 Total Reared: 137

Map 1: The San Bruno Mountains in 1980 before recent housing development began. Shaded areas denote urban and industrial development at that time. New housing now occupies the western peaks and parts of the north faces of the Crocker Hills. The top edge of the map coincides with the south city limits of San Francisco.







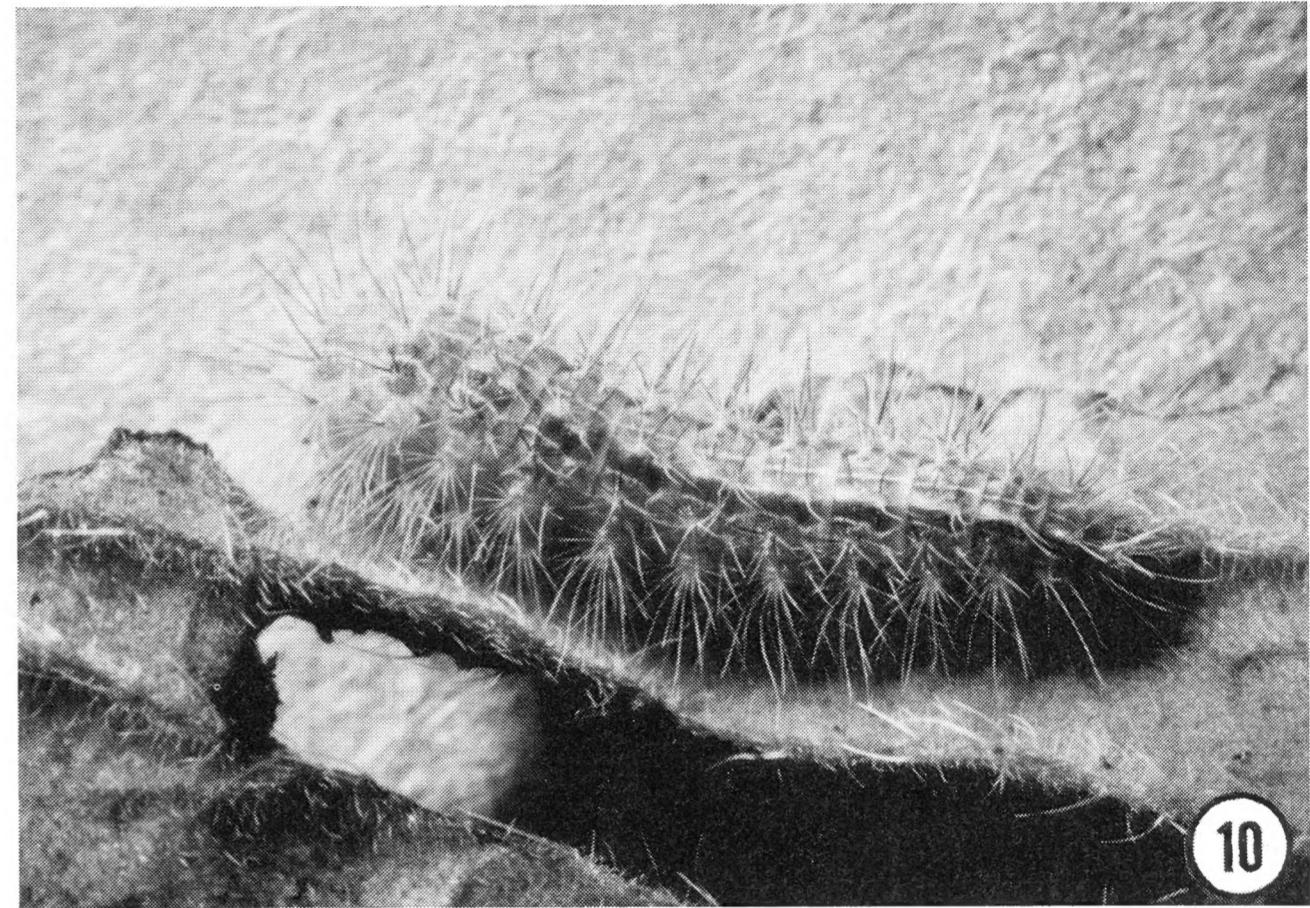
7



8



9



10

Figures 1-10: San Bruno Mountains microlepidopterous larvae: 1. A mature larva of the nepticulid *Stigmella variella* is faintly visible through the epidermis of its serpentine leaf mine on *Quercus agrifolia*. 2. The full depth blotch mine of the elachistid *Onceroptila cygnodiella* on a leaf of *Symporicarpos albus* var. *laevigatus*. 3. The mine of *Marmara* sp. (Gracillariidae) beneath the epidermis of a *Rubus* shoot. 4. The overwintering, prepupal larva of *Grapholita edwardsiana* (Tortricidae) within a split shoot of *Lupinus arboreus*. 5. The shaggy case of *Coleophora accordella* (Coleophoridae) from which it mines circular blotches on *Lotus scoparius* leaves. 6. The larva of the gelechiid *Gnorimoschema baccharisella* feeds on the inner surface of its subterminal gall on a shoot of *Baccharis pilularis*. 7. A leaf roll on *Quercus agrifolia* of the last or penultimate instar larva of the gracillariid *Caloptilia agrifoliella*. 8. The tentiform shelter of a later instar *Caloptilia palustriella* larva on *Salix lasiolepis*. 9. An unearthed, nearly full-grown larva of *Hepialus hectoides* (Hepialidae) that had fed externally upon roots just beneath the soil surface. 10. The cryptically colored larval pterophorid *Oidaematophorus phaceliae* consumes elongate patches from leaves of *Phacelia californica*.

EDITORIAL STAFF OF ATALA

Paul A. Opler
Editor
5100 Greenvie Court
Fort Collins, Colorado 80525

Mary Troychak
Production Manager
The Xerces Society
10 S.W. Ash
Portland, Oregon 97204

INSTRUCTIONS FOR CONTRIBUTORS

Formal scientific articles and notes dealing with any aspect of the ecology and conservation of invertebrates and their habitats are solicited. Articles will generally be longer papers, or notes not exceeding 1000 words. Reviews of books dealing with invertebrate conservation or endangered habitats are also invited.

All manuscripts should be typewritten on white, 8.5 x 11 inch, bond paper, on one side only, double- or triple-spaced throughout, with margins of at least one inch on all sides. Manuscripts produced on dot matrix printers are *unacceptable* unless the printer has been set in near letter quality mode. The original manuscript and two copies should be submitted; authors should also retain a copy of manuscripts and figures for later consultation with the editorial staff.

Include illustrations and/or black and white glossy photographs as appropriate. Figures should be consecutively numbered in Arabic numerals. Hand-drawn figures should be rendered in black ink on good quality white paper, and may be larger than the final reproduced size. These and artwork will be returned after publication if accompanied by return postage. Figure captions should be typed, double- or triple-spaced on a separate sheet, and the number of the figure lightly pencilled on the back of each drawing or photograph. A map should be included as a figure with all articles dealing in a major way with a specific region or invertebrate habitat. Tables should be numbered consecutively in Arabic numerals, and submitted on separate sheets in *camera-ready condition*. Cover art/photos change with each issue, and contributions will be gratefully received. Cover material should generally show invertebrates in natural settings, and prospective artists should consult with the Editor prior to submitting material.

The style of *Atala* generally follows that recommended in the *CBE Style Manual* (1972). Abbreviations of journal titles follow *Bibliographic Guide for Editors and Authors* (1974). Please include full scientific name for both plants and animals mentioned in any manuscript submitted for publication in *Atala*. Dimensions should be given in *metric* units. Full references to literature cited should appear in a separate section at the end of articles or commentary papers, but parenthetically incorporated within the text of notes. Please include an *informative abstract* of approximately 100-200 words with all articles. Avoid footnotes whenever possible; such information can usually be incorporated into the text. Words to be set in *italics* (including scientific names) should be underlined.

Page charges are \$10.00 per page, and waivable *only* when institutional funding is unavailable or when hardship can be demonstrated. Reprints of papers accepted for publication are available at cost. An author will receive an order form for reprints and page charge instructions at the time galleys are sent for inspection.

Submission of manuscripts on IBM-compatible ASCII files (disks or diskettes) is strongly encouraged. Turnaround times are much shorter, the possibility of entering an error during typesetting is greatly reduced, and Xerces staff time is minimized. Authors submitting electronically are entitled to a 50% reduction in the normal page charges, to \$5.00 per page. Authors interested in electronic submission of manuscripts should contact the Editor for details.



3 9088 01270 4805

ISSN 0160-5674

CONTENTS

Dense Colonies of the South Texas Tree Snail (*Rabdotus alternatus*): An Endangered Phenomenon?

Raymond W. Neck 1

The Skippers (Hesperioidea) of Rhode Island, with Recent Records of the True Butterflies (Papilioidea)

Harry Pavulaan 6

Larval Hosts of Microlepidoptera of the San Bruno Mountains, California

John A. De Benedictis, David L. Wagner, and James B. Whitfield 14

Cover: The checkered skipper, *Pyrgus communis* (Grote), a common butterfly throughout much of the southern United States and the American tropics. It is found in open weedy or similar sunny places where its larval hosts, various mallows, abound. (Copyright 1885. G.H. French, A.M. *The Butterflies of the Eastern United States*.)